ABSTRACTS OF NORTH AMERICAN GEOLOGY

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UNITED STATES DEPARTMENT OF THE INTERIOR
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ROGERS C. B. MORTON, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

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Assoc. Am. Geographers Proc.—Proceedings of the Association of American Geographers. Washington, D.C.

Florida Bur. Geology Leaflet—Florida Bureau of Geology Leaflet. State of Florida, Department of Natural Resources, Bureau of Geology Leaflet. Tallahassee, Fla.

Geoderma—Geoderma. An international uournal of soil science. Elsevier Publishing Company. Amsterdam, Netherlands.

Geophys. Fluid Dynamics—Geophysical Fluid Dynamics. A journal of the mechanics and energetics of atmospheres and oceans. Gordon and Breach Science Publishers. New York, N.Y., and London, England.

Idaho Dept. Water Adm. Water Inf. Bull.—Idaho Department of Water Administration Water Information Bulletin. Moscow, Idaho.

Mikrochim. Acta—Mikrochimica Acta. Archiv für Mikrochemie, Spurenanalyse und physikalisch-chemische Mikromethoden. Springer-Verlag. Vienna, Austria, and New York, N.Y.

Ontario Dept. Mines and Northern Affairs Prelim. Map—Ontario Department of Mines and Northern Affairs Preliminary Map. Toronto, Ontario, Canada.

Southern Illinois Studies—Southern Illinois Studies. Research Records of the University Museum. Southern Illinois Unversity. Carbondale, Illinois.

Underwater Sci. and Technology Jour.—Underwater Science and Technology Journal. Iliffe Science and Technology Publications Ltd. Guildford, Surrey, England, and New York, N.Y.

The abstracts in this were prepared by George W. Andrews, Fred Barker, Donald A. Brobst, Arthur P. Butler, Jr., Georgianna D. Conant, Howard R. Cramer, Andrew Griscom, Bernardo F. Grossling, Elizabeth Hambleton, Philip T. Hayes, Virginia M. Jussen, Ronald W. Kistler, E. R. Landis, Elisabeth S. Loud, Mildred C. Mead, Willis H. Nelson, Virginia S. Neuschel, Raymond L. Parker, John Schlee, J. M. Schopf, Marie Siegrist, Vernon E. Swanson, Ruth Todd, Gregg Vane, Dorothy B. Vitaliano, Holly C. Wagner, Walter S. White, Ray E. Wilcox, and Adel A. R. Zohdy.

ABSTRACTS

04358 **Acker, Louis L.; Hatcher, Robert D., Jr.** Relationships between structure and topography in northwest South Carolina: South Carolina Div. Geology Geol. Notes, v. 14, no. 2, p. 35-48, illus., 1970.

In the Blue Ridge and Brevard-Henderson-Poor Mountain belts, foliation, major lineation, and most minor folds trend northeast; structural grain cuts across the Blue Ridge Front in this area. Widely pirated, most streams trend N 30°-50° E and N 10° W to N 20° E; principal ones parallel major joint directions, N 40° E or N 40° W. Topography is dominated by dissected erosion surfaces at about 950, 1,600, and 2,300 feet elevations. On the second, between Chauga and Tugaloo Rivers, are maximum topographic expressions of the major joint lineaments; major streams have used the northwest set to breach the Blue Ridge escarpment and reduce it to a hilly terrain merging with the Piedmont. Northeast is a re-entrant in the Front where Blue Ridge and Brevard rocks cross into the Piedmont, and north-south and east-west drainage trends dominate. Some slopes on both sides of the Front are dip slopes, also present locally northwest of the Brevard zone along Chauga River and Brasstown Creek. — GDC

03947 **Adams, William H.** Some possible causes for late-Pleistocene faunal extinctions: Indiana Acad. Sci. Proc. 1969, v. 79, p. 65-68, 1970.

While Indiana has thus far not yielded a stratified early man site, the distribution of early type projectile points indicates that not only was he in Indiana but that he hunted the Pleistocene megafauna and contributed to their extinction. This paper examines the causes for these faunal extinctions and why, ultimately, the blame rests on man. — Author's abstract

Adham, Samy A. *See* Werner, Stuart D. 04394

Agarwal, R. G. *See* Kanasewich, E. R. 04275

04291 **Agterberg, F. P.** Toward a probability index for detecting favourable geological environments [abs.]: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 445, 1970.

Aki, Keiiti. *See* Tsai, Yi-Ben. 04276

Aki, Keiiti. *See* Tsai, Yi-Ben. 04333

04337 **Aki, Keiiti; DeFazio, Thomas; Reasenberg, Paul; Nur, Amos.** An active experiment with earthquake fault for an estimation of the in situ stress: Seismol. Soc. America Bull., v. 60, no. 4, p. 1315-1336, illus., tables, 1970.

An active experiment was attempted in the San Jacinto fault zone near Anza, Calif., for the purpose of measuring the tectonic stress believed to exist there. In a "trigger experiment" the near and far field of seismic waves from a buried explosion were measured in an attempt to detect a possible explosion-triggered microearthquake. The radiation pattern of seismic waves from such a microearthquake should indicate the nature of existing tectonic stress. In a "shaker experiment," a precise measurement of change of apparent seismic velocity was made before and after the explosion in the nearby granitic rocks. The results were negative, indicating that the above size of the experiment is not large enough for the purpose, and also that rocks at shallow depths in the fault zone are cracked in place and may not be capable of sustaining tectonic stress. — DBV

04240 **Albers, John P.; Kleinhampl, Frank J.** Spatial relation of mineral deposits to Tertiary volcanic centers in Nevada, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C1-C10, illus., table, 1970.

About 80 major Tertiary volcanic centers have been recognized in Nevada. Some 17 are either certain or possible calderas ranging in diameter from 3 to 25 miles. Associated with 35 of the 80 centers are spatially related mineral deposits. The more important ones are in the following districts: Bullfrog (gold, silver), Daisy (fluorspar), Goldfield (gold, silver), Tonopah (silver), Silver Peak (silver), Bodie and Aurora (gold and silver), Comstock (silver, gold), and Opalite (mercury). Geologic settings typical of deposits associated with volcanic centers include: (1) rim fracture zones of calderas; (2) areas of local uplift that may reflect the intrusion of an igneous body; and (3) groups of veins, breccia pipes, and breccia zones near the heart of a volcanic center, which may dip inward toward the presumed center. — Authors' abstract

Alexander, Charles S. *See* Patton, Clyde P. 04126

04421 **Allen, R. J.; Martin, D. F.; Taft, W. H.** A study of the effects of selected amino acids on the recrystallization of aragonite to calcite: Jour. Inorganic and Nuclear Chemistry, v. 32, no. 9, p. 2963-2970, illus., tables, 1970.

Transformation kinetics of metastable aragonite to stable calcite, have been measured for the heterogenous system of solids in contact with solutions of amino acids at 23°C. Kinetic data are consistent with the pseudo first-order catalytic process and follow a rate expression $\ln A_o/(A_o\text{-}C) = kt$ where A_o is amount of aragonite and C is amount of calcite at time t. Under conditions of constant pH and temperature, rate constant k is a function of concentration of added amino acids as well as nature of amino acids. The value of k decreases with increasing concentration of added organic compound until a minimum limiting rate constant, k_{min}, is attained. The value k_{min} and concentration of amino acid needed to attain the value do not seem related to known or anticipated tendencies of these materials to form calcium complexes. Those amino acids that produce aragonite as a primary precipitate also retard crystallization. — *from* Authors' abstract

03877 **Am. Comm. Stratigraphic Nomenclature.** Code of stratigraphic nomenclature [as amended from the 1961 code]: Tulsa, Okla., Am. Assoc. Petroleum Geologists, 22 p., 1970.

Amendments to the 1961 code (Am. Assoc. Petroleum Geologists Bull., v. 45, no. 5, p. 645-665, 1961) approved by the Commission appear in five subsequent notes, nos. 28, 30, 33, 35, and 36, in the Am. Assoc. Petroleum Geologists Bulletins of October 1962, May 1964, March 1966, September 1967, and September 1969. The articles of this code are recommendations that cannot be generally mandatory, but may be adopted by geological organizations as their rules of nomenclatorial procedure. — GDC

Ames, H. T. *See* Traverse, A. 03886

03996 **Andersen, N. R.; Gassaway, J. D.; Maloney, W. E.** The relationship of the strontium:chlorinity ratio to water masses in the tropical Atlantic Ocean and Caribbean Sea: Limnology and Oceanography, v. 15, no. 3, p. 467-472, illus., tables, 1970.

The strontium:chlorinity ratios of sea water from 5 hydrographic stations in the Atlantic Ocean are statistically compared to 4 in the Caribbean Sea using discriminant analysis. The variation of this chemical parameter is consistent with the physical oceanographic description of water flow into the Caribbean Sea. Increased mixing of the inflowing waters that results from the bottom topography, because of location of the sill in the Lesser Antillean Arc, is suggested as the physical mechanism for the variation in the observed strontium:chlorinity ratio; the chemical basis for the initial variability in this ratio is not known. — Authors' abstract

Anderson, C. H. *See* Halliday, W. R. 04004

04080 **Anderson, F. D.** Geology, Big Bald Mountain, New Brunswick: Canada Geol. Survey Map 1220A, scale 1:50,000, text, 1970.

Because of the scarcity of outcrop, absence of fossils, few exposed contacts, and complexity of structure, the stratigraphic sequence in the Big Bald Mountain area is unknown; it is possible the mapped units are not stratigraphically significant. Map units, structural geology, and sulfide deposits are described. — MCM

04251 **Anderson, L. A.; Johnson, G. R.** Application of magnetic and electrical resistivity methods to placer investigations in the Fairbanks district, Alaska, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C107-C113, illus., 1970.

Magnetic and electrical resistivity sounding surveys were made in an area of known placer gold deposits near Fairbanks, Alaska, to evaluate effectiveness of these methods in locating placer deposits containing magnetic minerals. Near Happy, where bedrock is several hundred feet beneath the surface, it was necessary to apply a low-pass filtering process to observed magnetic data in order that magnetic anomalies associated with placer deposits be recognized. In the narrow valley of Goldstream Creek, where bedrock is at a depth of about 170 feet, placer minerals can easily be detected by the magnetic method. Bedrock depth determinations from resistivity soundings in areas free of permafrost agreed favorably with existing drill hole data; in areas underlain by permafrost no meaningful bedrock depths could be determined from resistivity data. — *from* Authors' abstract

04134 **Andrews, George W.** Late Miocene nonmarine diatoms from the Kilgore area, Cherry County, Nebraska: U.S. Geol. Survey Prof. Paper 683-A, p. A1-A24, illus., table, 1970.

The Valentine Formation contains diatomaceous and plant-bearing sediments of late Miocene age at a locality on the north bluff of the Niobrara River, about 10 miles south of the village of Kilgore, Cherry County, Neb. The fossil flora and a correlative vertebrate fauna near Valentine, Neb., both previously studied, confirm the age of the diatomaceous deposit as late Miocene. Forty-five species and varieties of nonmarine diatoms have been identified in the Kilgore deposit. Of these, 4 species are recorded as new, 1 has been previously reported from the middle Pliocene, and the remainder are still living in nonmarine environments. The diatoms were deposited in a small, hard-water, perhaps slightly saline lake. The assemblage is significant for stratigraphic correlation because of its position near the Miocene-Pliocene boundary. — GWA

Andrews, Henry N., Jr. *See* Kasper, Andrew E., Jr. 04164

03977 **Archambeau, Charles; Sammis, Charles.** Seismic radiation from explosions in prestressed media and the measurement of tectonic stress in the Earth: Rev. Geophysics and Space Physics, v. 8, no. 3, p. 473-499, illus., 1970.

The radiation field from explosions in a prestressed medium can be theoretically predicted on the basis of a dynamic theory of stress relaxation in the vicinity of the shock-induced fracture zone created by an explosion. The nature of the radiation field to be expected from such a source in an inhomogeneous earth is considered, and the stress field required to explain observations from a large underground explosion is determined. The field is described in terms of radiation patterns as functions of frequency or alternately as amplitude and phase spectrums at particular distances. Theoretical predictions are compared to Love- and Rayleigh-wave radiation patterns and spectra from nuclear explosion Bilby. Using known source parameters, agreement is obtained between observed radiation patterns and predicted patterns for a pure shear prestress field equivalent to a shear couple oriented N. 10° W. The prestress was found to be 70 ± 20 bars in the source area. This approach can be used for systematically measuring the Earth's stress field. — *from* Authors' abstract

04142 **Arem, Joel E.** Preserving mineral localities: Mineralog. Rec., v. 1, no. 2, p. 39, 67, 1970.

Mineral collectors who take for granted free access to operating mines and quarries must rely on the good will of commercial enterprise in order to recover specimen material. Most frequently the management destroys much nice mineralization in order to produce profitably. Mineral specimens fall into the category of esthetic qualities of our environment. The mine operator should be conscious of the mineralogical content of his property, and be made aware of the scientific value of specimen material, as well as the esthetics. Collectors, by following rules for gaining access, safety regulations, and policing by group leaders, may avoid abusing their privilege; local residents and mineral clubs help to keep quarries open to collectors, by acting as intermediaries with owners. — GDC

Armstrong, D. E. *See* Sommers, L. E. 04061

04016 **Armstrong, Richard Lee; Besançon, James.** A Triassic time scale dilemma—K-Ar dating of Upper Triassic mafic igneous rocks, eastern U.S.A. and Canada and post-Upper Triassic plutons, western Idaho, U.S.A.: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 15-28, illus., tables, 1970.

K-Ar dates for Newark Group dolerite dikes and sills and basalt flows cluster about 200 m.y. with a scatter toward lower values. Dates for dolerite dikes in Connecticut, Pennsylvania, Virginia, and North Carolina are in the range 220-244 m.y., concentrated at 225-230 m.y. Intrusive igneous rocks in western Idaho that cross-cut marine Upper Triassic strata have been dated as about 206 m.y. Both groups of data conflict with accepted estimates of the age of the Triassic-Jurassic boundary. Zeolite facies "burial" metamorphism of the Newark Group sediments and volcanics may explain the cluster of dates around 200 m.y. An explanation consistent with published dates proposes a Triassic-Jurassic boundary at about 210 m.y., invoking Ar loss during metamorphism to explain low dates and the possibility of extraneous Ar to explain dates above 227 m.y. obtained for two dikes with exceptionally low K content. — *from* Authors' abstract

Arnold, R. W. *See* Witty, J. E. 03936

Ashley, R. P. *See* Silberman, M. L. 04322

03788 **Atwood, D. K.; Bubb, J. N.** Distribution of dolomite in a tidal flat environment, Sugarloaf Key, Florida: Jour. Geology, v. 78, no. 4, p. 499-505, illus., table, 1970.

The distribution of previously reported penecontemporaneous dolomite was determined to be mainly in a near-surface crust 1-4 inches thick of Holocene tidal flat sediment near the shoreline and within topographic lows on the flats where the sediment is kept the most wet by tide water. Dolomite is present in lesser amounts in unconsolidated sediments, and decreases toward interior and higher parts of the flats, with essentially no dolomite in adjacent bay sediments. Interstitial sediment water, collected at different times in the year, was very similar in salinity and chemistry to sea water, which suggests that sea water is the source of the Mg^{++} for dolomitization. — VES

Ault, Curtis H. *See* Rooney, Lawrence F. 03787

04181 **Austin, S. Ralph.** Some patterns of sulfur isotope distribution in uranium deposits: Earth Sci. Bull., v. 3, no. 2, p. 5-22, illus., table, 1970.

Distribution patterns are discernible in sulfur isotope composition in sandstone-type uranium deposits. In four ore "rolls" from three Wyoming districts, δ S-34 increases sharply from barren interior to ore, at or near the natural contact or solution front, then gradually from ore to protore. Probable biological reduction of sulfur is an important part of the ore-forming process. S-32 enrichment for sulfides associated with woody or coaly material is confirmed. Lightest sulfur (δ S-34 = -53.11 per mil) is in marcasite associated with petroleum along a fault in a uranium deposit in Texas. In samples from Wyoming and Colorado sulfur in sulfides from Se-rich zones is light, that associated with Mo is heavier. Relatively heavy sulfur (δ S-34 = -5.0 per mil) in sulfides from the Sunset pit, western ore trend, Gas Hills, Wyoming, suggests a broad areal pattern. — *from* Author's abstract

Ave'Lallemant, Hans G. *See* Carter, Neville L. 03774

03775 **Ave'Lallemant, Hans G.; Carter, Neville L.** Syntectonic recrystallization of olivine and modes of flow in the upper mantle: Geol. Soc. America Bull., v. 81, no. 8, p. 2203-2220, illus., 1970.

Olivine in dunite, peridotite, and olivine powder has been recrystallized during compression tests at temperatures from 950°C to 1350°C, confining pressures from 5 to 30 kb, and strain rates from 10^{-3} to 10^{-4}/sec. Experimental fabrics are similar to those of natural olivine tectonites. Syntectonic recrystallization is proposed as an important or dominant mode of flow in the upper mantle. Seismic implications of this conclusion are discussed in the light of plate tectonics. — AG

03878 **Averitt, Paul; Carter, M. Devereux.** Selected sources of information on United States and world energy resources, an annotated bibliography: U.S. Geol. Survey Circ. 641, 21 p., 1970.

This bibliography is a revision and an updating of an earlier bibliography on the same subject by Trumbull (U.S. Geol. Survey Circ. 447, 1961). References are grouped under: general, petroleum and natural gas, coal, waterpower, atomic energy, bituminous sands and asphalt, oil shale, geothermal energy, solar energy, tidal power, synthetic liquid fuel and gas, and electricity. — MCM

04028 **Averitt, Paul.** Stripping coal resources of the United States — January 1, 1970: U.S. Geol. Survey Bull. 1322, 34 p., illus., tables, 1970.

An analysis by states of the geologic and technologic sources of information on stripping coal indicates that as of January 1, 1970, the remaining recoverable resources of stripping coal in the United States in the 0- to 150-overburden category totaled 128 billion tons. This figure is 29 times the cumulative strip-coal production from the beginning of mining to January 1, 1970, and it is 690 times the 1969 strip-coal production of about 185 million tons. — PA

Avignone, Joseph M. *See* McLaughlin, R. E. 04043

Ayer, N. J. *See* Lineback, J. A. 03917

03893 **Baadsgaard, H.; vanBreemen, O.** Thermally-induced migration of Rb and Sr in an adamellite: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 31-44, illus., tables, 1970.

Heating of a coarse-grained, two-mica quartz monzonite or adamellite in air produces definite migration and relocation of Rb and Sr without volatilization loss. Rb and Sr-87 are lost by muscovite and biotite, while normal Sr increases in both minerals. It is difficult to establish the change in Sr-87 content in the plagioclase. Apatite definitely gains Sr-87 and a little Rb. Migration is detectable only above 800°C with a 100-hr heating period, and extensive partial fusion occurs at 1025°C. Microprobe studies indicate no apparent diffusion gradients within mineral grains nor any significant intergrain accumulation of Na, K, or Ca. The ability of an ion to migrate between silicate lattices is apparently more a function of chemical-thermodynamic factors than of volume diffusion. When allowable, the migration of an ion appears to proceed relatively rapidly and reversibly. — *from* Authors' abstract

Baadsgaard, Halfdan. *See* Folinsbee, Robert E. 03923

04129 **Back, William; Hanshaw, Bruce B.** Comparison of chemical hydrogeology of the carbonate peninsulas of Florida and Yucatan: Jour. Hydrology, v. 10, no. 4, p. 330-368, illus., tables, 1970.

These areas have similar Tertiary limestone aquifers, but contrast in hydrologic and geochemical systems. Gently rolling Florida has many rivers; flat and lower, northern Yucatan has none. Thickness of fresh ground water, up to 700 m in Florida, is less than 70 m in Yucatan; average gradient of potentiometric surfaces, in Florida about 1 m per km, is only 0.02 m per km in Yucatan. Water chemistry changes systematically downgradient in Florida, due to solution of aquifer minerals and increases in

total dissolved solids, sulfate, calcium, and Mg-Ca ratio; in Yucatan no downgradient change exists, controlling processes are solution and simple mixing of fresh water and shallow underlying body of salt water. With no impervious cover hydrologically equivalent to the confining Hawthorne Formation of Florida, rainfall in Yucatan immediately infiltrates the karst to the water table, then moves to coastal discharge areas. — GDC

04067 **Backus, George.** A geometrical picture of anisotropic elastic tensors: Rev. Geophysics and Space Physics, v. 8, no. 3, p. 633-671, illus., 1970.

A geometrical picture of fourth-order, three-dimensional elastic tensors in terms of Maxwell multipoles is developed and used to obtain the elastic tensors appropriate to various crystal symmetry groups. Simply examining the picture shows whether an elastic tensor, described by its 21 independent components relative to an ill-chosen coordinate system, has an axis of symmetry of any order. The picture also facilitates obtaining the elastic tensor from the observed dependence of the three body-wave phase velocities. Our description of elastic tensors is generalized to all fourth-order tensors in three dimensions and certain fourth-order tensors in higher dimensions. — *from* Author's abstract

04418 **Bailey, Edgar H.; Blake, M. C., Jr.; Jones, David L.** On-land Mesozoic oceanic crust in California Coast Ranges, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C70-C81, illus., tables, 1970.

Basal mudstones of the Jurassic-Cretaceous Great Valley sequence rest depositionally on an ophiolite ultramafic-mafic succession consisting of chert; keratophyric to basaltic lavas; diabase, gabbro, or norite; and serpentinized peridotite. Comparison of occurrence, lithology, and thickness with the present in situ sea floor indicates ophiolite is the exposed Mesozoic oceanic crust on which sedimentary rocks of the Great Valley sequence were deposited; coeval eugeosynclinal rocks of the Franciscan assemblage have been dragged below the rocks of the Great Valley sequence by sea-floor spreading; Coast Range thrust separates the Franciscan and Great Valley sequence. Serpentine immediately above the thrust is the basal part of the Mesozoic oceanic crust lying beneath the Great Valley sedimentary rocks and thus was present before thrusting commenced. — *from* Authors' abstract

04049 **Baker, David W.** On the symmetry of orientation distribution in crystal aggregates, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 435-454, illus., tables, 1970.

Data from the X-ray pole-figure goniometer are processed numerically to obtain a suite of complete and normalized pole-figures. From these the preferred orientation of the grains in a monomineralic aggregate is determined using spherical harmonic analysis and represented as a frequency distribution of the Euler angles, termed the orientation distribution function (ODF). When frequency density of grain orientation is plotted in a Cartesian coordinate system with the angles as axes, it must have a translation periodicity of 2π or less along each axis, because Euler angles are angles of rotation. The ODF must have a symmetry corresponding to one of the 230 crystallographic space groups that reflects the crystal point group symmetry and that of the specimen. This symmetry has been derived for combinations of specimen and crystal symmetries commonly used. Analysis of a naturally deformed quartzite illustrates these rules. — *from* Author's abstract

04405 **Baldwin, Andrew B.** Uranium and thorium occurrences on the north shore of the Gulf of St. Lawrence: Canadian Mining and Metall. Bull., v. 63, no. 698, p. 699-707, illus., geol. maps, 1970.

Uranium and thorium mineralization occurs at several localities along the north shore; main occurrences are near Sept-Iles, Baie Johan Beetz, Romaine and St-Augustin River, mainly as disseminated uraninite, uranothorite, uranothorianite, monazite and minor zircon and allanite. Oxidation products are observed along fracture planes of the uranium-bearing deposits to a depth of a few feet. Magnetite, biotite and smoky quartz accompany the radioactive minerals. Host rocks include

white to pink pegmatite, pink granite and also, in the Romaine and St-Augustin River occurrences, cream to grey plagioclase-rich, paragneiss and migmatite. Radioactivity near fractures and joint planes indicates some reconstitution of radioactive minerals. The North Shore of Quebec is the northeast extension of the Grenville sub-province, and is also a uranium-thorium metallogenic province. — *from* Author's abstract

03927 **Baldwin, Brewster.** Problem-approach guidelines applied to Dolores Peak quadrangle: Jour. Geol. Education, v. 18, no. 4, p. 155-160, illus., 1970.

The introductory geology laboratory program should provide progression from facts to data and then inferences at several levels. Significant problems can be posed if students are encouraged to help each other in acquiring the necessary tools. A set of exercises uses the geologic map of Dolores Peak quadrangle, Colo., to explore the concept and implications of the geologic contact. This problem serves as an example in design, preparation of materials, and analysis of a laboratory problem for introductory geology. — *from* Author's abstract

04204 **Bandy, Orville L.** (editor). Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, 247 p., illus., tables, 1970.

This volume includes papers from the Annual Symposium for the Society of Economic Paleontologists and Mineralogists, April 1967, Los Angeles; six of the papers and two additional contributions are cited separately. — GDC

04388 **Bandy, Orville L.; Ingle, James C., Jr.** Neogene planktonic events and radiometric scale, California, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 131-172, illus., table, 1970.

Current radiometric dates in marine Neogene strata of California suggest revision in correlating classic biostratigraphic units with the radiometric scale. K-Ar dates for bases, in m.y., are: lower Miocene 24.5, near base of Saucesian Stage; middle Miocene 19+, within Relizian; upper Miocene about 14, at base of Mohnian. The Miocene-Pliocene (Delmontian-Repettian) is no older than 9 m.y.; Pliocene-Pleistocene, 3 m.y.; and Pleistocene-Holocene about 11,000 B.P. Significant species of planktonic Foraminifera within each Miocene stage in California are named, with stratigraphic range, abundances, and changes in features, particularly coiling directions. Cold cycles are indicated in upper Miocene and later intervals. Correlations with planktonic indices in tropical zones, and Mohole core sections near Guadalupe Island are approximate. Few tropical reports refer to Zemorrian nannofossils in California. — GDC

03894 **Banghar, A. R.** New tables of angles of incidence of P waves as a function of epicentral distance: Earthquake Notes, v. 41, no. 2, p. 45-58, table, 1970.

We have calculated the angles of incidence of P waves at the focus and at the surface of the earth for P tables of Herrin, et al (1968). These angles are given in a tabular form in this paper. — Author's abstract

04367 **Banks, E.; Greenblatt, M.; Post, B.** The crystal structures of synthetic spodiosites, Ca_2VO_4Cl and Ca_2AsO_4Cl: Inorganic Chemistry, v. 9, no. 10, p. 2259-2264, illus., tables, 1970.

The crystal structures of Ca_2VO_4Cl and Ca_2AsO_4Cl isomorphous with the spodiosite analogs Ca_2PO_4Cl and Ca_2CrO_4Cl have been determined. Both compounds crystallize in the orthorhombic system space group D_{2h}^{11}-Pbcm, with four molecules per unit cell. The cell constants are given. Refinement of the atomic coordinates was carried out by full-matrix least-squares procedures (final R is 0.021 for Ca_2VO_4Cl and 0.023 for Ca_2AsO_4Cl). The structures are made up of discrete XO_4^{3-} tetrahedra held together by calcium ions. The XO_4^{3-} tetrahedra are significantly distorted from ideal tetrahedral symmetry in all four crystals. — *from* Authors' abstract

Banks, H. P. *See* Scheckler, S. E. 04165

Bankston, Donald C. *See* Thompson, Geoffrey. 04084

04295 **Barakso, J. J.; Tarnocai, C.** A mercury determination method and its use for exploration in British Columbia: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 501-505, illus., tables, 1970.

This paper outlines a method of testing for the mercury content of rocks, soils and plants. Techniques of sample collecting are described and the analytical procedures outlined. Examples are given of mercury determinations in two known mineralized areas in British Columbia, Copper Mountain Mines and Pacific Nickel Mines. — Authors' abstract

Barefoot, R. R. *See* Foscolos, A. E. 04200

Barefoot, R. R. *See* Foscolos, A. E. 04384

Barnes, Robert H. *See* Wilson, Charles W., Jr. 04077

03827 **Barnett, Stockton Gordon.** Upper Cayugan and Helderbergian stratigraphy of southeastern New York and northern New Jersey: Geol. Soc. America Bull., v. 81, no. 8, p. 2375-2402, illus., 1970.

Study of stratigraphic sections in the Green Pond-Schunemunk Mountain outlier and along the main Silurian-Devonian outcrop belt 25 mi to the northwest has resulted in alteration and refinement of regional stratigraphic relations. Two new units in the outlier are here proposed — the Berkshire Valley Formation and the Orrs Mills Member of the Rondout Formation. Tentative paleoenvironment analysis has resulted in recognition of eight facies. The approximate geographic distribution of paleoenvironments at eight successive horizons are shown on lithofacies-paleoenvironmental maps. It can be inferred that the report area was situated on the eastern side of a generally deepening northern Appalachian basin. A sediment source was continually active in eastern Pennsylvania south of the main outcrop belt, whereas a source east of the northern part of the outlier was active only during late Helderbergian. — *from* Author's abstract

Barron, T. H. K. *See* Harris, J. W. 04409

04014 **Bateman, Paul C.; Lockwood, John P.** Kaiser Peak quadrangle, central Sierra Nevada, California — Analytic data: U.S. Geol. Survey Prof. Paper 644-C, p. C1-C15, illus., table, 1970.

Modal data on the granitic rocks and chemical data on the granitic and metamorphic rocks of the Kaiser Peak quadrangle are presented. A simplified geologic map showing steeply dipping regional joints is included. — Authors' abstract

04160 **Baxter, Robert W.** A comparison of the Pennsylvanian seed genera *Mitrospermum* and *Kamaraspermum* [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 758, 1970.

04168 **Baxter, Robert W.** A new lycopod cone genus from the Middle Pennsylvanian of Kansas [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 756, 1970.

04162 **Beck, C. B.** Stelar morphology in some progymnosperms [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 755, 1970.

04163 **Beck, C. B.; Chase, N. L.** On the anatomy and morphology of *Archaeopteris* fronds [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 755, 1970.

03966 **Beck, Myri E., Jr.** Paleomagnetism of Keweenawan intrusive rocks, Minnesota: Jour. Geophys. Research, v. 75, no. 26, p. 4985-4996, illus., tables, 1970.

A paleomagnetic pole position calculated for 131 sites in normally magnetized Keweenawan intrusive rock from Minnesota lies at 34.5° N., 168.5° W. Gabbro and diabase of reverse polarity are known only from a limited area near the Canadian border. R-polarity sites yield a pole position of 42.5° N., 156.5° W., and probably are older than the N-polarity sites. Magnetic intensities vary by 4 orders of magnitude; these and differences in lithology reflect active igneous differentiation. On the basis

of current evidence, polar wandering relative to North America is best described by a southwestwardly-trending path several tens of degrees in width. Under favorable circumstances positions within the path of polar wandering can be used for long-distance geological correlation. An example is given for Precambrian basaltic volcanism in North America. — DBV

04215 **Becker, Herman F.** A proposed new catalogue of Cenozoic and Mesozoic plants of North America [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 759, 1970.

Bell, Keith. *See* Powell, J. L. 03771

04183 **Benedict, James B.** Downslope soil movement in a Colorado alpine region, rates, processes and climatic significance: Arctic and Alpine Research, v. 2, no. 3, p. 165-226, illus., tables, 1970.

Soil-movement rates, processes, and landforms were studied above timberline on the east slope of the Colorado Front Range. Maximum rates of downslope movement measured at nine test sites on Niwot Ridge ranged from 0.4 to 4.3 cm/yr. Rates of displacement were strongly influenced by differences in moisture availability and gradient, but were relatively unaffected by differences in soil texture and temperature. Movement is currently confined to the upper 50 cm of soil. Stratigraphic evidence and radiocarbon dating of soils and of charcoal associated with artifacts of prehistoric man were used to date advances of lobes and terraces. The effect of solifluction as the dominant movement process was replaced by frost-creep during the latest Pinedale and earliest Neoglacial ice advances. — *from* Author's abstract

04339 **Ben-Menahem, Ari; Rosenman, Martin; Harkrider, David G.** Fast evaluation of source parameters from isolated surface-wave signals — Pt. 1, Universal tables: Seismol. Soc. America Bull., v. 60, no. 4, p. 1337-1387, illus., tables, 1970.

Tables for spectral displacements of seismic surface waves from shear dislocations in flat multilayered earth models were prepared. Earth response functions for 3 Rayleigh and 4 Love-wave modes at 6 periods and 3 paths (continental, oceanic, shield) were calculated for the source-depth range of 10 to 600 km at intervals of 5 km until 200 km, and thereafter at intervals of 10 km. Ground motion is given in micron-seconds for the three fundamental shear dislocations. The tables provide the means for rapid evaluation of source parameters from spectral radiation patterns of amplitudes and initial phases. — *from* Authors' abstract

Bergenback, R. E. *See* Eason, J. E. 03972

04059 **Berger, Wolfgang H.** Planktonic foraminifera, differential production and expatriation off Baja California: Limnology and Oceanography, v. 15, no. 2, p. 183-204, illus., tables, 1970.

Species composition, living-to-dead ratios, morphology, and size distribution of planktonic foraminifera were studied from 54 depth-controlled (0-3,000 m) paired tow samples off Baja California, Mexico. Minimum replacement time for living populations was calculated from average concentrations of living vs. empty shells to 10,000 m depth. The living assemblage is a mixture of northern species dominant at surface and below 1,500 m, central species abundant just below the surface, and southern species most abundant at about 1,000 m, apparently corresponding to a subsurface northward countercurrent. It is suggested that the fauna of the oxygen-poor intermediate water is expatriated and that its high proportion of kummerforms (with small terminal chambers) is due to environmental stress. The proportion of kummerforms in ancient deep-sea sediments may be a measure of oceanic mixing at time of deposition. — VMJ

Bergin, M. J. *See* Hosterman, John W. 04248

04237 **Bergstrom, Robert E.** (compiler). Geology for planning at Crescent City, Illinois: Illinois Geol. Survey Environmental Geology Note 36, 15 p., illus., 1970.

This report, requested following heavy damage by explosions and fires from derailed railroad tank cars of propane, is devoted to a six-mile square centered on Crescent City. It is based mainly on studies of surficial geology by David L. Gross, engineering geology by Paul B. DuMontelle, ground-water conditions by Abdullatif Hamdan, and waste-disposal conditions by Frank B. Sherman. These studies supplement data from the files of the Geological Survey. No unusual or difficult geological limitations exist in this glaciated area. Lake sediments in the northern and western halves are generally fine-grained and impermeable; ground water has been generally available from sand and gravel at base of glacial drift, with many flowing wells; deeper bedrock water is too highly mineralized. An Ordovician gas-storage structure is well protected. — GDC

Besançon, James. *See* Armstrong, Richard Lee. 04016

03828 **Best, M. G.** Kaersutite-peridotite inclusions and kindred megacrysts in basanitic lavas, Grand Canyon, Arizona: Contr. Mineralogy and Petrology, v. 27, no. 1, p. 25-44, illus., tables, 1970.

Two types of ultrabasic inclusions occur in these lavas. Abundant, olivine-rich nodules contain a green, chrome-rich diopside and chrome-rich spinel; a much less common group containing poikilitic kaersutite has more variable modal compositions, but iron-rich-chrome-poor minerals, and characterized by titaniferous clinopyroxene. These latter types, together with megacrysts of kaersutite and black clinopyroxene, are discussed. The origin was as accumulates of fractionating basaltic magma with high crystallization pressures (near 10 kb). Pressures of this sort are near the mantle-crust boundary in the western Grand Canyon. Worldwide occurrences of kaersutite-bearing inclusions, always in undersaturated host rocks show the kaersutites to be compositionally uniform whether coexistent with pyropic garnet-clinopyroxene, with orthopyroxene-clinopyroxene-olivine-Mg spinel (Grand Canyon), or with plagioclase-clinopyroxene-olivine-magnetite (shallow igneous bodies). These occurrences imply the precipitation of kaersutite amphibole over a broad range of pressures, and as high as those prevailing in the upper mantle. — *from* Author's abstract

04288 **Bhattacharyya, B. K.; Holroyd, M. T.** Numerical treatment and automatic mapping of two-dimensional data in digital form [abs.]: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 441, 1970.

04038 **Bickley, William B., Jr.** Gigantism in a recent gastropod, *Gyraulus parvus* (Say), from south-central Alaska: Compass, v. 47, no. 3, p. 183-184, table, 1970.

Recent mollusks collected from the Tasnuna Valley, south-central Alaska, included specimens of *Gyraulus parvus* (Say). Gigantism was observed in some specimens of this species. — Author's abstract

Bisque, Ramon E. *See* Ong, H. Ling. 04256

Bisque, Ramon E. *See* Pyrih, Roman Z. 04324

Blake, M. C., Jr. *See* Bailey, Edgar H. 04418

04119 **Blander, Milton; Keil, Klaus; Nelson, Lloyd S.; Skaggs, Samuel R.** Heating of basalts with a carbon dioxide laser: Science, v. 170, no. 3956, p. 435-438, illus., table, 1970.

Basalts heated strongly with focused infrared laser radiation vaporized and splattered. Electron microprobe analyses of condensate, ejecta, and residue show strong vapor fractionation trends which, for some elements, are different from what would be expected theoretically and from previously reported data on more siliceous materials. It appears that solution effects can account for these differences. Heating of materials by a powerful focused laser beam for the purpose of study of vapor fractionation is a convenient technique that is more versatile than previous methods such as heating in solar or arc image furnaces. — Authors' abstract

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Bodvarsson, Gunnar. *See* Emilia, David A. 03939

04347 **Boettcher, A. L.** The system CaO-Al_2O_3-SiO_2-H_2O at high pressures and temperatures: Jour. Petrology, v. 11, no. 2, p. 337-379, illus., tables, 1970.

Results of experimental investigations under pressure-temperature conditions ranging from 580-1150°C and up to 35 kb are reported, and a schematic P-T projection for 50 univariant reactions within the system is developed. The data serve as a basis for a model of melting and the role of H_2O in the mantle, as well as for interpretation of P-T conditions during regional and contact metamorphism. Consideration of the stability of plagioclase of intermediate composition leads to the conclusion that plagioclase is stable to higher pressures than albite or anorthite. — MS

Bollinger, G. A. *See* Hopper, Margaret G. 04018

04115 **Bolt, Bruce A.; Qamar, A.** Upper bound to the density jump at the boundary of the Earth's inner core: Nature, v. 228, no. 5267, p. 148-150, illus., 1970.

The recent discovery that the Earth's inner core is about the size of the Moon confirms the earlier identified PKiKP waves reflected at grazing angles from the inner core boundary ($\Delta = 105°$-$110°$), and establishes once and for all that the inner core radius (about 1,216 km) is sharp relative to longitudinal waves with periods of order 1 sec. It also opens the way for direct calculation, by purely seismologic means, of the density contrast between the outer and inner core. Tentative calculations suggest a maximum density jump of less than 1.8 g per cu cm. Seismologic evidence alone thus can establish that, 1,200 km from the Earth's center, the density does not exceed 14.25 g per cu cm. This result is in close agreement with recent core models of Bullen (1963), and also with Birch's (1963) conclusions that the Earth's central density is close to 13 g per cu cm. — DBV

03891 **Bonatti, E.** Deep sea volcanism: Naturwissenschaften, v. 57, no. 8, p. 379-384, illus., table, 1970.

Volcanic activity is the main process by which new crustal material is created along active oceanic ridges. Ridge volcanism consists of "quiet" fissural emissions of large quantities of fluid basalt. Volcanism associated with seamounts is characterized by intense reactions of lava with sea water and the formation of hyaloclastites; such reactions ultimately give rise to sediments rich in authigenic zeolites and sinectites, common over large areas of the sea floor. Mineralogical and geochemical anomalies in deep-sea sediments, which are especially intense near active ridges and rifts, can be attributed to hydrothermal activity. — DBV

03948 **Boneham, Roger F.** Acritarchs (*Leiosphaeridia*) in the New Albany Shale of southern Indiana: Indiana Acad. Sci. Proc. 1969, v. 79, p. 254-262, illus., table, 1970.

The Devonian-Mississippian New Albany Shale of southern Indiana is one of the numerous black shale facies in central and eastern North America. The shale is divided into five lithologically distinct members. These members contain varying percentages of two acritarchs *Leiosphaeridia plicata* Felix and *L. linebacki* sp.n. The mean percentages of these two species are sufficiently different in the uppermost Clegg Creek and Camp Run Members to separate them from the lower members. *Leiosphaeridia* may be a useful genus for stratigraphic separation of other black shales. — Author's abstract

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04289 **Borgman, L. E.** The use of non-stationary stochastic processes in ore reserve reliability estimation [abs.]: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 441, 1970.

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Bornhold, Brian D. *See* Pilkey, Orrin H. 04243

04114 **Bostrom, R. C.; Sherif, M. A.** Disposal of waste material in tectonic sinks: Nature, v. 228, no. 5267, p. 154-156, illus., 1970.

Restricted localities on the sea floor are the site of downwarping and rapid sedimentary burial connected with events taking place in the Earth's interior. In sedimentary sinks located within zones of subduction, deposited material is buried within a few months and will never be seen again. If the world's industrial and domestic refuse could be deposited in compacted form at the foot of foreset beds of certain river deltas, it would be buried as fast as it is produced. To utilize such sedimentary sinks would require locating and mapping zones of intense deposition, investigating behavior of waste materials as it becomes deeply buried, and examining the economics of transporting material to sinks distant from its source. The principal benefit of this form of disposal would be that its effect on the environment would not be cumulative. The ultimate effect might be the discovery of a distinctive and perhaps puzzling suite of metamorphic rocks. — DBV

03938 **Bott, M. H. P.; Hutton, M. A.** Limitations on the resolution possible in the direct interpretation of marine magnetic anomalies (*Comment on* "Numerical methods in the direct interpretation of marine magnetic anomalies," *by* D. A. Emilia and G. Bodvarsson [1969]): Earth and Planetary Sci. Letters, v. 8, no. 4, p. 317-319, illus., 1970.

Emilia and Bodvarsson (ibid., v. 7, p. 194-200, 1969; Abs. North American Geology, June 1970) represent layer 2 by a series of specified two-dimensional rectangular blocks of constant width (W) and vertical thickness (T) but variable depth (D) to the top of each block. The value of the intensity of magnetization of each block is then evaluated from the observed magnetic anomalies by solution of a set of linear equations. They make the ratio D/W equal to 3 beneath the crest of the ridge. We suggest that the use of such a narrow block width in relation to depth gives an optimistic view of the resolution possible. — *from* Authors' abstract

Boureau, Édouard. *See* Prakash, Uttam. 04365

04167 **Brack, S. D.; Taylor, T. N.** Transmission and scanning electron microscopy of *Endosporites* [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 756, 1970.

Bradley, W. F. *See* Henderson, G. V. 04279

04197 **Bradley, W. H.** Eocene algae and plant hairs from the Green River Formation of Wyoming: Am. Jour. Botany, v. 57, no. 7, p. 782-785, illus., 1970.

Four new species of algae and two kinds of fossil plant hairs are described from a rich oil shale bed of the mid-Eocene Green River Formation of Wyoming. Two of the algae belong to the Cyanophyceae and two to the Chlorophyceae. On the basis of their morphology alone, they are assigned to four new species among four genera as follows: *Symploca hedraia*, sp.n., *Stigonema anchistina* sp.n., *Schizochlamys haywellensis*, sp.n., and *Spirogyra wyomingia* sp.n. One kind of fossil plant hair is similar to those observed in organic sediments of an existing lake and identified with trichomes on the under surface of live oak leaves (*Quercus virginiana*). Assignment of the fossil trichomes to a taxon is not warranted at present. — Author's abstract

03914 **Brady, Philip.** Prowling America's oldest mica mine: Gems and Minerals, no. 396, p. 28-29, illus., 1970.

New Hampshire's Ruggles Mine atop Isinglass Mountain in Grafton still produces valuable minerals for collectors, after almost 170 years of use. Its history is briefly reviewed, from the discovery of mica in 1803 to the present winter production of feldspar. Opened to public visitors since 1962, over 150 minerals are found there. — GDC

04143 **Brannock, Kent C.** Specimen cleaning reagents: Mineralog. Rec., v. 1, no. 2, p. 45, 1970.

Reviewed are possible dangers involved in the chemicals commonly used to clean mineral specimens, with some guidelines for their use. To be avoided are the extremely toxic cyanides, and sulfuric and nitric acids which can cause severe burns. Recommended with safety precautions are oxalic acid (except for calcitic minerals), hydrochloric acid, acetic acid (or vinegar), and sodium bisulfite (or sodium metabisulfite). Emphasized are their dilution in use, good ventilation, and thorough rinsing of specimens to remove residual acid. — GDC

03910 **Branson, F. A.; Miller, R. F.; McQueen, I. S.** Plant communities and associated soil and water factors on shale-derived soils in northeastern Montana: Ecology, v. 51, no. 3, p. 391-407, illus., 1970.

Sites on different strata of Bearpaw shale on a hillslope and on shale-derived alluvium in Willow Creek valley support long-established, strikingly different plant communities. Several physical and chemical soil factors were measured for the seven upland and seven lowland communities; only total soil-moisture stress and soil-moisture volume give a rational ordination of the plant communities. Moisture is held at higher stress level, and infiltration rates are lower, in clayey than in sandy soils. Total soil-moisture stress at average root depth ranged from 96 bars for a Nuttall saltbush community to 19 bars for a mixed shrub community, with intermediate values for a big sagebrush community. Soil salinity relations alone give inconsistent results. Ranges of tolerance to soil-moisture stress are shown for 13 species; those with narrow ranges should be the most useful indicators in different habitats. — VMJ

Bratt, J. G. *See* Swain, F. M. 04095

Braun, W. K. *See* Norford, B. S. 04100

Bray, J. G. *See* Naldrett, A. J. 04413

Bremner, J. M. *See* Tabatabai, M. A. 03932

Brent, Gayle. *See* Golubic, Stjepko. 03872

03779 **Bretsky, Peter W.; Lorenz, Douglas M.** An essay on genetic-adaptive strategies and mass extinctions: Geol. Soc. America Bull., v. 81, no. 8, p. 2449-2456, illus., 1970.

Three simple relationships are formulated from Paleozoic fossil and Holocene faunal data: (1) Environmental stability is positively correlated with diversity; (2) environmental stability is negatively correlated with long-term biotic stability; and (3) therefore, diversity is negatively correlated with biotic stability. To explain these observed correlations, we propose an evolutionary model based on genetic-adaptive strategies. A prolonged period of stability could significantly reduce a species' potential for survival in a more rigorous environment, and hence might be expected to precede a time of widespread or mass extinction. — HCW

04118 **British Columbia University.** (Department of Geology). Abstracts of published papers, theses, and oral presentations of the students and faculty, Department of Geology, July 1, 1969 to June 30, 1970: British Columbia Univ. Dept. Geology Rept. 11, 67 p. [1970].

04027 **Brobst, Donald A.** Barite — World production, reserves and future prospects: U.S. Geol. Survey Bull. 1321, 46 p., illus., tables, 1970.

World reserves of barite tabulated by country are in 1969 about 200 million tons, an amount equal to that required in the next 20 years if demand rises no faster than during the past 20 years. World barite production 1850-1967 was 83 million tons, but nearly 60 million tons were mined during 1946-67. At least 80 percent of world barite is consumed in drilling mud for oil and gas wells; the remainder is used chiefly in the chemical, glass, paint, and rubber industries. Barite consumption likely will continue to rise. Geologic factors suggest that world barite production and reserves can be increased. Possibilities are good for the discovery of new, large, high-grade bedded barite deposits similar to those already known. — DAB

03911 **Brodkorb, Pierce.** The generic position of a Cretaceous bird: Florida Acad. Sci. Quart. Jour. 1969, v. 32, no. 3, p. 239-240, 1970.

Palintropus, n.gen., is here proposed for *Cimolopteryx retusus* Marsh, 1892, a primitive charadriiform bird from the latest Cretaceous Lance Formation of Wyoming. Brodkorb (1963) had referred the species to *Apatornis* Marsh, but this was unsatisfactory because the type species of that genus is of much earlier Late Cretaceous age and is closely related to *Ichthyornis*. In the Lance Formation, the family Cimolopterygidae Brodkorb, 1963 is now known from five species referable to three genera; it is also represented in the Hell Creek Formation of Montana. — VMJ

Broecker, W. S. *See* Wolgemuth, K. 04449

04441 **Broecker, Wallace S.** A boundary condition on the evolution of atmospheric oxygen: Jour. Geophys. Research, v. 75, no. 18, p. 3553-3557, illus., tables, 1970.

The constancy of the C-13/C-12 ratio in marine carbonate over the last half-billion years provides evidence that an amount of organic carbon comparable to that presently contained in the Earth's sedimentary reservoir must have existed in early Paleozoic time. Since the amount of organic carbon is a direct measure of the net amount of oxygen produced by photosynthesis, this in turn implies no great change in available oxygen over that time period. Finally, unless the distribution of oxygen between the bound and molecular form has undergone a large change, the oxygen content of the atmosphere must have been comparable to its present value in early Paleozoic time. — Author's abstract

Broise, Y. *See* Thorley, A. 04177

04112 **Brookins, Douglas G.; Chaudhuri, Sambudhas; Dulekoz, Erhan.** Rb-Sr isotopic age of Eskridge Shale (Lower Permian), eastern Kansas: Sed. Geology, v. 4, no. 2, p. 103-115, illus., tables, 1970.

Twelve whole-rock samples of Eskridge Shale with Rb-87/Sr-86 ratios greater than 1 define a least-squares isochron of 300 ± 4 m.y. age with initial Sr-87/Sr-86 = 0.7116 ± 0.0006 using 50 b.y. as half life of Rb-87. Fourteen whole-rock samples of Eskridge Shale with Rb-87/Sr-86 ratios less than 1 show a random distribution in both coordinates and are considered unsuitable for age work. The 300 ± 4 m.y. age is considered a maximum age of formation for the shale because: it contains an abundance of $2M_1$ illite of allogenic origin, and it is higher than the proposed 270-280 m.y.(?) age for the Pennsylvanian-Permian boundary which lies only about 280 feet below the Eskridge Shale. — *from* Authors' abstract

04284 **Brown, Bahngrell W.** Error in lead anomalous stream sediments: Econ. Geology, v. 65, no. 4, p. 514-515, 1970.

Geochemical studies in Alaska have indicated that galena in a subarctic environment is relatively stable and prospectors should not expect much migrant or adsorbed lead ions in stream sediments. Extreme caution in interpretation of stream sediment geochemistry is urged. A more mobile ion such as Zn or Cu should be coupled with Pb to discriminate meaningful Pb anomalies from those due to placering, and replicate samples should be determined in proximity at the sample site to minimize effect of placer error. — VSN

04351 **Brown, E. T.; Hudson, J. A.** The operational strength of fissured clays — Discussion [of paper by K. Y. Lo, 1970]: Géotechnique, v. 20, no. 3, p. 334-336, 1970.

This paper was published, ibid., v. 20, no. 1, p. 57-74, 1970. (See Abs. North American Geology, January 1971.) Feeling that the author contributed false and misleading statements regarding Weibull's statistical theory, the writers correct errors and suggest another way of deriving the equation claimed to be used by Weibull. — GDC

Brown, Floyd W. *See* Dorrzapf, Anthony F., Jr. 03887

03959 **Brown, J. D.** Some observations on the undrained shearing strength used to analyze a failure — Discussion [of paper by F. A. DeLory and R. J. Salvas, 1969]: Canadian Geotech. Jour., v. 7, no. 3, p. 343-344, 1970.

The original paper was published, ibid., v. 6, no. 2, p. 97-110, 1969; *see* Abs. North American Geology, February 1970. Brown expresses doubt as to whether the [Ontario] clays studied can be considered normally-consolidated, and questions the validity of the comparison of DeLory and Salvas of $c\mu/p'$ ratios in equations representing shear behavior in field vane and laboratory tests. — GDC

Brown, Jerry. *See* Lewellen, Robert. 04108

04102 **Brown, Lynn A.** Strain distribution around underground openings — Tech. Rept. 3, Data bank — Underground openings rock deformation measurements (abstracts) (Advanced Research Projects Agency Contract DACA 73-68-C-0002(P002)): Washington, D.C., Office Chief of Engineers, Dept. Army, 256 p., illus., tables, 1970.

This report presents abstracts of published articles and related information containing measurement of data of stress, strain or deformation; cases are restricted to underground openings in rock. The data bank provides a list of underground openings of varying span widths with recorded data. Each case contains the following information: opening number, reference, location and purpose of opening, geologic situation, rock properties and types of tests used, opening geometry, instrument type and location, and stress, strain, or displacement data. Many abstracts include a few representative graphs or tables. An index relating type of measuring device to openings, and a list of publications reviewed are appended. — MCM

04345 **Brown, Robert D., Jr.** Map showing recently active breaks along the San Andreas and related faults between the northern Gabilan Range and Cholame Valley, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-575, scale 1:62,5000, text, 1970.

North of Middle Mountain the line of faulting trends about N. 40° W. and is very nearly straight; atypical and unusual fault patterns are apparent at several places. South of the mountain the fault is essentially continuous, and approximately a straight line except near the broadest part of Cholame Valley; here the fault lacks the segmented character that is exhibited to the north. Fault movement to the north is a form of tectonic creep, to the south it is spasmodic. For the past half century, the fault south of Middle Mountain shows a rate about half of that to the north. — MCM

03984 **Burne, Gunnar.** How much underground water storage capacity does Texas have?: Water Resources Bull., v. 6, no. 4, p. 588-601, illus., tables, 1970.

Water imported into Texas under the Texas Water Plan must be stored in surface or underground reservoirs. Ground-water levels are being drawn down heavily in many parts of Texas. This is causing a shift of much water from a surface- to a ground-water environment. The lowering water tables have resulted in a great reduction in wastage of water through evapotranspiration and spring and well flow. The methods used in estimating the quantities of underground storage capacity available in Texas are discussed. Some problems will be encountered in the use of dewatered underground storage capacity by artificial recharge. In spite of these problems, probably 60 to 70 percent of the dewatered storage capacity of Texas aquifers can be reused for ground-water storage. Most of this capacity is located where it can be used in conjunction with the Texas Water Plan. — Author's abstract

04056 **Bruscato, Frank N.; McHenry, J. Roger.** Evaluation of selected cobalt-60 complexes as tracers of groundwater: Jour. Hydrology, v. 10, no. 4, p. 406-417, illus., tables, 1970.

A series of Co-60 compounds, considered potentially useful tracers of ground-water movement, was prepared and evaluated in soil column and batch studies. The compounds were: potassium hexacyanocobaltate(III), potassium ethylenediaminetetraacetato-cobaltate(III), ammonium 12-tungstodicobaltoate(III), chloraquotetrammine cobalt(III) chloride, and sodium hexanitrocobaltate(III). Per-

formance of the first two were dependent on their environment and more especially on type and amount of clay present. The EDTA cobalt complex cannot be used in soils that are basic or where a large fraction of the clay is saturated with Na^{+} and/or Ca^{++}. Of other radioactive tracers tested, none were suitable for ground-water tracing because of instability in aqueous solution, variable anionic structure under acid conditions, or preferential uptake by the clay fraction. — *from* Authors' abstract

03903 **Bryan, M. Leonard.** Sedimentation in Kluane Lake, Yukon Territory, Canada: Assoc. Am. Geographers Proc., v. 2, p. 31-35, illus., tables, 1970.

Preliminary investigations on the bathymetry and sediments of the southern portion of Kluane Lake, Yukon Territory, were conducted during the summer of 1968. Statistical relationships of sediment particle size, minimum distance traveled by sediments through the lake, and depth are not as hypothesized in conventional simplistic models of sedimentation. Processes affecting the observed relationships are considered to be lake stratification, currents, and wave activity. Suggestions for continuing research are discussed. — Author's abstract

Bubb, J. N. *See* Atwood, D. K. 03788

Buhl, P. *See* Houtz, R. 03968

04438 **Bunch, T. E.; Keil, Klaus; Olsen, E.** Mineralogy and petrology of silicate inclusions in iron meteorites: Contr. Mineralogy and Petrology, v. 25, no. 4, p. 297-340, illus., tables, 1970.

Silicate inclusions in 17 iron meteorites are classified, according to their phase assemblages, compositions, and textures, into three major types: Odessa, Copiapo, and Weekeroo Station, and into three miscellaneous types: Enon, Kendall County, and Netschaëvo. Phase compositions in Odessa- and Copiapo-types are similar, but the two types differ in texture and constituent phases. Weekeroo Station-type is different in every respect. Minor element distributions among coexisting ferromagnesian silicates in Odessa and Copiapo follow consistent patterns and are constant for any given sample, indicating equilibrium; whereas major and minor element distributions for Weekeroo Stations are anomalous, indicating nonequilibrium. Compositional and other data suggest that many of the inclusions did not form cogenetically with the iron host, but represent pre-existing stony material taken up by an iron melt. — *from* Authors' abstract

04368 **Buravas, S.; Gaines, A. F.; Hasadsri, T.; Prasertwitayakij, A.; Sucharitakul, Mrs. N.** The infra-red spectra of Tertiary lignites: Fuel, v. 49, no. 2, p. 180-187, illus., table, 1970.

The infrared spectrums of Tertiary lignites are related to their chemical structure and geology. Pleistocene (62-67 percent C) lignites and woody peat gave spectrums similar to lignites, especially in having peaks at 1,500, 1,450, and 1,410 cm^{-1}. Pliocene-Paleocene (66-74 percent C) lignites showed no peak at 1,500 cm^{-1} and broad absorption throughout the region 1,450-1,400 cm^{-1}, while coals showed marked absorption in this region only at 1,450 cm^{-1}. Attention is drawn to the fact that lignites show no infrared absorption by aromatic C-H stretching vibrations. Chars prepared by pyrolysis of lignites did show absorption by aromatic C-H stretching vibrations, confirming that dehydrogenation of the lignites took place during pyrolysis. Infra-red spectra of some chemically treated lignites have been recorded. — GV

03905 **Bush, W. R.; Hafner, S. S.; Virgo, D.** Some ordering of iron and magnesium at the octahedrally coordinated sites in a magnesium-rich olivine: Nature, v. 227, no. 5265, p. 1339-1341, illus., tables, 1970.

The Mössbauer spectrums of Fe-57 in three olivines were investigated at adsorber temperatures between 77° K and 700° C. The results suggest that the Mg and Fe distribution in Fe-rich olivine is almost entirely disordered, while in Mg-rich chrysolite there is about 10 percent more Fe in one of the nonequivalent M positions. Heat

treatment at 915° C for 24 hours and subsequent quenching in liquid nitrogen did not change the distribution. The apparently different degree of disorder in two samples is not indicative of different crystallization or cooling histories. The linear relationship between lattice constants and composition does not necessarily imply that the Mg and Fe distribution at each nonequivalent site is close to ideal. Judging from the generally high degree of Mg, Fe disorder in natural olivines, the exchange energy for the Mg, Fe exchange must be quite small. — DBV

03937 **Bushue, L. J.; Fehrenbacher, J. B.; Ray, B. W.** Exhumed paleosols and associated modern till soils in western Illinois: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 665-669, illus., table, 1970.

Illinoian and Kansan till-derived paleosols exposed on side slopes by stream incision and erosion in predominantly loess regions of western Illinois are finer textured, thicker, and more strongly developed than modern soils formed in the same tills during late Pleistocene and Recent weathering. There are only slight chemical differences between the paleosols and the modern soils. The modern till soils are normally lower in the landscape. — Soil brief

04110 **Byrd, William J.** Geology of the Ely Springs Range, Lincoln County, Nevada: Earth Sci. Bull., v. 3, no. 2, p. 23-32, illus., 1970.

Current mapping substantially modifies present knowledge of the Ely Springs Range as reported by Westgate and Knopf (1932) and by Tschanz and Pampeyan (1961). Silurian rocks reported by Westgate are correlated with the Laketown Dolomite and crop out more extensively than previously reported, predominating in the eastern part of the range which was previously mapped as underlain by Ely Springs Dolomite. In the central part of the range, rocks previously mapped as Tank Hill Limestone are referable to the Kanosh Shale and Lehman Formation of Hintze (1951), but the rocks of the Yellow Hill Formation are not satisfactorily correlatable with early Ordovician units recognized elsewhere in the region. The Mendha Limestone, Ely Springs Dolomite, and Eureka Quartzite are recognized and mapped essentially as in earlier works. — Author's abstract

Cady, J. G. *See* Daniels, R. B. 03935

04159 **Cahoon, E. J.** *Paraphyllanthoxylon* from Alabama [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 759, 1970.

04296 **Calder, Peter N.** Slope stability in jointed rock: Canadian Mining and Metall. Bull., v. 63, no. 697, p. 586-590, illus., 1970.

The orientation of planes of inherent weakness (joints) with reference to an excavation in rock is the critical factor determining stability. The purely frictional 'residual' strength remaining following the breakdown of initial cohesion is the only strength which can be counted on to resist sliding for the long term. A simple method of resolving driving and resisting forces in three dimensions along joint intersections 'undercut' by the excavation is presented. Contrary to the base of slope failure in soils, it is shown how significant changes in the slope angle sometimes have no effect on the degree of stability present in rock slopes. Wall control by reorientation of the slope, the use of cable bolts and water diversion are briefly discussed. — Author's abstract

Calhoon, M. L. *See* Thorley, A. 04177

Callahan, J. A. *See* Shattles, D. E. 03888

Cameron, Christopher P. *See* Stone, David B. 04179

04302 **Campbell, Richard B.; Tipper, Howard W.** Geology and mineral exploration potential of the Quesnel Trough, British Columbia: Canadian Mining and Metall. Bull., v. 63, no. 699, p. 785-790, illus., geol. maps, 1970.

The trough is underlain by a thick sequence of Upper Triassic and Lower Jurassic volcanic-clastic and sedimentary rocks lying between deformed Proterozoic and Paleozoic rocks to the east and the upper Paleozoic Cache Creek Group to the west. Broad areas of the trough are covered by Tertiary volcanics and sediments. Granitic intrusions were confined to two major episodes, 200 and 100 m.y. ago. Outcrops are small and scattered, making prospecting difficult. The part of the trough discussed is the northwest extension of the copper-rich Kamloops-Merritt-Princeton region. Molybdenum prospects are restricted to the 100-m.y. granitic rocks, but copper prospects are most prominent in volcanic-clastic rocks and in the 200-m.y.-old granitic rocks, so that copper has a wide potential distribution. The region deserves careful and comprehensive exploration. All major pre-Tertiary geologic elements seem to have potential for mineral deposits. — *from* Authors' abstract

03835 **Canada Geological Survey.** Aeromagnetic series, Bentley Bay, Saskatchewan: Canada Geol. Survey Geophysics Paper 4786, scale 1:63,360, 1970.

03836 **Canada Geological Survey.** Aeromagnetic series, Belanger, Saskatchewan: Canada Geol. Survey Geophysics Paper 4787, scale 1:63,360, 1970.

03837 **Canada Geological Survey.** Aeromagnetic series, Pinehouse Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4796, scale 1:63,360, 1970.

03838 **Canada Geological Survey.** Aeromagnetic series, Sandfly Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4797, scale 1:63,360, 1970.

03839 **Canada Geological Survey.** Aeromagnetic series, Black Bear Island Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4798, scale 1:63,360, 1970.

03840 **Canada Geological Survey.** Aeromagnetic series, Agumik Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4806, scale 1:63,360, 1970.

03841 **Canada Geological Survey.** Aeromagnetic series, Bar Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4807, scale 1:63,360, 1970.

03842 **Canada Geological Survey.** Aeromagnetic series, Clam Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4808, scale 1:63,360, 1970.

03843 **Canada Geological Survey.** Aeromagnetic series, McLurg Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4816, scale 1:63,360, 1970.

03844 **Canada Geological Survey.** Aeromagnetic series, Moose Portage, Saskatchewan: Canada Geol. Survey Geophysics Paper 4817, scale 1:63,360, 1970.

03845 **Canada Geological Survey.** Aeromagnetic series, Morin Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4818, scale 1:63,360, 1970.

03846 **Canada Geological Survey.** Aeromagnetic series, La Ronge, Saskatchewan: Canada Geol. Survey Geophysics Paper 4819, scale 1:63,360, 1970.

03847 **Canada Geological Survey.** Aeromagnetic series, Hunter Bay, Saskatchewan: Canada Geol. Survey Geophysics Paper 4820, scale 1:63,360, 1970.

03848 **Canada Geological Survey.** Aeromagnetic series, Sheets 65 L/5, 65 L/6, 65 L/7, 65 L/8, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Papers 6886-6889, scale 1:63,360, 1970.

03849 **Canada Geological Survey.** Aeromagnetic series, Sheets 65 K/5, 65 K/6, 65 K/7, 65 K/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Papers 6890-6893, scale 1:63,360, 1970.

03850 **Canada Geological Survey.** Aeromagnetic series, Sheets 65 J/5, 65 J/6, 65 J/7, 65 J/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Papers 6894-6897, scale 1:63,360, 1970.

03895 **Canada Geological Survey.** Aeromagnetic series, Sheets 13 C/1, 13 C/8, 13 C/9, 13 C/16, 13 K/8, 13 K/16, Newfoundland: Canada Geol. Survey Geophysics Papers 5922, 5942, 5973, 5992, 6091, 6136, 6180, scale 1:63,360, 1970.

03896 **Canada Geological Survey.** Aeromagnetic series, Traverspine River, Newfoundland: Canada Geol. Survey Geophysics Paper 6023, scale 1:63,360, 1970.

03897 **Canada Geological Survey.** Aeromagnetic series, Goose Bay, Newfoundland: Canada Geol. Survey Geophysics Paper 6042, scale 1:63,360, 1970.

03898 **Canada Geological Survey.** Aeromagnetic series, North West River, Newfoundland: Canada Geol. Survey Geophysics Paper 6073, scale 1:63,360, 1970.

03899 **Canada Geological Survey.** Aeromagnetic series, Mulligan River, Newfoundland: Canada Geol. Survey Geophysics Paper 6122, scale 1:63,360, 1970.

03900 **Canada Geological Survey.** Aeromagnetic series, West Micmac Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 6167, scale 1:63,360, 1970.

04098 **Canada Geological Survey.** Report of activities — Pt. B., November 1969 to March 1970: Canada Geol. Survey Paper 70-1, pt. B, 99 p., illus., tables, 1970.

This report comprises thirty-five short papers that describe research [in fields of analytical chemistry, Cordilleran geology, exploration geophysics, lunar studies, metamorphic petrology, mineral deposits, mineralogy, stratigraphy, general, and exploration geophysics] carried out by members of the Geological Survey of Canada between November 1969 and March 1970. Some are illustrated by photographs and line drawings. — Author's abstract

04099 **Canada Geological Survey.** 1969-1970 index of publications of the Geological Survey of Canada: Canada Geol. Survey Paper 70-3, 76 p., 1970.

This index lists Geological Survey of Canada publications issued from April 1, 1969 to March 31, 1970.

04190 **Canada Geological Survey.** Nickel in Canada: Canada Geol. Survey Map 1258A, scale 1:5,000,000, text, 1970.

Classification of Canadian nickel deposits is based upon geologic factors and known size. Most promising areas for discovery of new deposits are those containing ultramafic bodies of the alpine type; these rocks form part of the core zones of many eugeosynclinal belts in the Precambrian Shield, and in the Cordillera. Nickel content of most ultramafic rocks averages about 0.2 percent. A 261-item bibliography is appended to the text. — MCM

04037 **Caramanica, Frank P.** Sedimentary control of Middle Devonian corals: Compass, v. 47, no. 3, p. 174-182, illus., tables, 1970.

The Middle Devonian tabulate and rugose coral fauna in the Mahantango Formation of northeastern Pennsylvania exhibits patterns of development which coincide with a landward coarsening of clastic sedimentary rocks. Decreased species diversity and numbers of individual coralla, increased predominance of branching colonial coralla, and a decreased proportion of massive and solitary coralla within the fauna accompany this landward coarsening. This reduced development of the fauna indicates that the most unfavorable environments for coral development occurred more landward than did those more favorable to corals. — Author's abstract

03776 **Carl, James D.** Block faulting and development of drainage, northern Madison Mountains, Montana: Geol. Soc. America Bull., v. 81, no. 8, p. 2287-2297, illus., 1970.

The northern Madison Mountains consist of at least three east-west-trending, elongate fault blocks that achieved most of their elevation by Eocene time. The blocks were either (1) initially downfaulted, eroded of all Mesozoic and most Paleozoic

strata, and then uplifted, or (2) uplifted without downfaulting, but varied in relative rates of uplift. A subdued topography developed on metamorphic rocks. Fault blocks were buried by a northward-sloping plain of Oligocene-Miocene sediment. Consequent streams on the plain were diverted by highlands of the central fault block. Stream courses were influenced by the slope of the plain, barriers to northerly drainage, exhumed Tertiary valleys, and lowering of base level brought about by the Madison River. Tertiary topography was partially exhumed. — Author's abstract

04062 **Carr, Roderick A.** Salinity effects on the determination of strontium in seawater by atomic absorption spectrophotometry: Limnology and Oceanography, v. 15, no. 2, p. 318-320, tables, 1970.

Salinity differences between samples and standards may be a source of error in the determination of strontium in sea water by atomic absorption spectrophotometry. If calibration is by reference to artificially prepared standards, these standards must match the sample solutions in salinity. Recently published values for strontium in the marine environment, determined by atomic absorption using standard solutions of different salinities (Billings and Harriss, 1965; Billings and Angino, 1965; Angino et al., 1966) are probably too low. — *from* Author's abstract

04152 **Carsey, J. Ben.** Livingston Pierson Teas: Houston Geol. Soc. Bull., v. 13, no. 1, p. 27, 1970.

Carter, M. Devereux. *See* Averitt, Paul. 03878

Carter, M. W. *See* Thurston, P. C. 03791

03774 **Carter, Neville L.; Ave'Lallemant, Hans G.** High temperature flow of dunite and peridotite: Geol. Soc. America Bull., v. 81, no. 8, p. 2181-2202, illus., 1970.

About 300 deformation experiments in solid pressure media apparatus on dunite and peridotite, both in the presence and absence of externally released water, were carried out at constant strain rate in the range 10^{-3} to 10^{-4}/sec, temperatures ranging from 300° to 1400°C, and confining pressures from 5 to 30 kb. Extrapolation of the results to geological strain rates under the physical conditions of the upper mantle yields values of shear stress and viscosity in accord with estimates based upon other geophysical observations. Results suggest flow in the upper mantle may be governed primarily by a non-linear creep law. — AG

Carter, Neville L. *See* Ave'Lallemant, Hans G. 03775

Casida, L. E. *See* Given, P. H. 04091

03934 **Cescas, Michel P.; Tyner, Edward H.; Harmer, Richard S., 3d.** Ferromanganiferous soil concretions — A scanning electron microscope study of their micropore structures: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 641-644, illus., 1970.

The micropore structural features of zoned and non-zoned concretions were examined to establish whether these features might provide some insights into the genesis of these chemically and morphologically different concretions which occur together in the plow-depth layer of Flanagan silt loam [in Illinois]. — Soil brief

Chamney, T. P. *See* Norford, B. S. 04100

Chan, Frank L. *See* Johnson, Gerald G., Jr. 04052

04422 **Chandra, Umesh.** Stationary phase approximation in focal mechanism determination: Seismol. Soc. America Bull., v. 60, no. 4, p. 1221-1229, illus., tables, 1970.

Tests of the stationary phase approximation method applied to P waves for the determination of focal mechanisms have been carried through for eight earthquakes selected from different geographic locations and depth ranges. The results are found to be in close agreement with the solutions obtained from S-wave polarization data

for four earthquakes and in reasonable agreement for three earthquakes. In general, however, the P polarities are more consistent with S-wave polarization solutions than with the solutions obtained by the present method. The stationary phase solutions agree with the P-wave spectrum solutions determined in a previous study. The method is applicable to shallow-focus earthquakes, and to earthquakes of large magnitude in which methods using S-wave polarization data and P-wave spectrums are difficult to apply. — Author's abstract

04220 **Chang, Chin-Yung; Duncan, James M.** Analyses of soil movement around a deep excavation: Am. Soc. Civil Engineers Proc., v. 96, paper 7512, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1655-1681, illus., tables, 1970.

The investigation was performed to study soil movements around the 160-ft deep excavation for Buena Vista Pumping Plant in southern California. The calculated movements were compared with the observed movements around the excavation. The study described to calculate soil movements consists of two parts: the first involved conducting laboratory tests on undisturbed soil specimens to determine the strength and nonlinear properties of the soil around the excavation, and the second involved performing finite element analyses using the nonlinear soil properties to calculate soil movements and stresses at the end of excavation. The results of these analyses were found to agree well with the observed behavior of the excavation, with regard to both the magnitude of soil movements and the development of regions of local failure. — ASCE abstract

Chang, Chin-Yung. *See* Duncan, James M. 04221

Chapman, Sheri L. *See* Ralston, Dale R. 04013

Chase, N. L. *See* Beck, C. B. 04163

04402 **Chaterlain, A.; Kline, D.; Kolopus, J. L.; Weeks, R. A.** Electron and nuclear magnetic resonance of three chondritic meteorites: Jour. Geophys. Research, v. 75, no. 29, p. 5681-5692, illus., 1970.

Resonance spectrums of samples from the Bruderheim, Homestead, and Pueblito de Allende chondrites were resolved into contributions attributed to Fe^{3+}, Mn^{2+}, and Cr^{3+}. The resonances attributed to Mn^{2+} were found only in some of the chondrules in Pueblito de Allende, which contained single crystal grains large with respect to sample size. The Cr^{3+} resonance, tentatively attributed to chromite detected in Pueblito de Allende and presumed to be present in the other two, is frequency dependent; to explain this it is assumed that magnetic fields were induced in the samples when the laboratory field was applied and disappeared on its removal. The resonance attributed to Fe^{3+} was most intense, and absorption was observed over the entire range of 0 to 19,000 gauss. — DBV

Chaudhuri, Sambudhas. *See* Brookins, Douglas G. 04112

Chen, Albert T-F. *See* Schiffman, Robert L. 04226

Cherry, R. N. *See* Mann, J. A. 03912

04278 **Chichester, F. W.; Harward, M. E.; Youngberg, C. T.** pH dependent ion exchange properties of soils and clays from Mazama pumice [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 2, p. 81-90, illus., tables, 1970.

Cation exchange capacity measurements made for whole pumice soil samples indicated that vesicular pores affected attainment of ion diffusion equilibria, and introduced a large error in measurements; validity of exchange values obtained was dubious. More important, the solute and/or solution exclusion or retention exhibited was thought to be highly significant to properties of soils in the field. Interpretation of pH dependent exchange capacity measurements of the $<2\mu$ clay fraction was compounded by hydroxy interlayered 2:1 phyllosilicates mixed with amorphous components. Since these contributed an indeterminate proportion of the total pH depen-

dent charge, it was concluded that this measurement was of little value in assessing relative amounts of amorphous and crystalline components. Values obtained did reveal aspects of exchange behavior important to understanding the complex systems. — *from* Authors' abstract

04369 **Chomnanti, S.** (and others). A study of an oil shale: Fuel, v. 49, no. 2, p. 188-196, illus., table, 1970.

A detailed comparison is made between the chemistry and structure of an oil shale and those of lignite. It is suggested that oil shales give phenols on pyrolysis only when they have been derived from vegetation containing lignins. A table gives the percentages of ash, C, H, and OH in oil shale and upper and lower lignite and the infrared spectra of oil shales are shown in a diagram. — GV

04082 **Chow, T. J.; Earl, J. L.** Lead and uranium in Pennsylvanian anthracite: Chem. Geology, v. 6, no. 1, p. 43-49, illus., tables, 1970.

Lead concentration, its isotopic composition, and the uranium content of Pennsylvanian anthracites have been determined. From the isotopic analysis, it is interpreted that common lead was incorporated into the ancient, bedded plant material in Carboniferous times prior to coalification, while the uranium was introduced into the anthracite after coalification. — Authors' abstract

Chrismas, L. P. *See* Latour, B. A. 04117

03969 **Chung, D. H.; Wang, Herbert; Simmons, Gene.** On the calculation of the seismic parameter ϕ at high pressure and high temperatures: Jour. Geophys. Research, v. 75, no. 26, p. 5113-5120, illus., tables, 1970.

Comparison of the Murnaghan equation of state with the Birch equation shows that for a given pressure, the values of (ρ/ρ_o) calculated from the two equations differ by less than 1 percent to a pressure equal to half the zero-pressure isothermal bulk modulus, but corresponding values of the seismic parameter ϕ differ by 10 percent. Because it is the derivative of pressure with respect to density, ϕ is extremely sensitive to the choice of the equation of state. Good agreement between the two equations of state for pressure as a function of density does not imply the same agreement in $\phi(P)$. Expressions for $\phi(P)$ that take into account the first order nonlinear dependence of the bulk modulus on pressure are presented, and their applications are discussed. Temperature correction of the pressure-dependent ϕ is also considered. — DBV

03873 **Churkin, Michael, Jr.; Jaeger, Herman; Eberlein, G. Donald.** Lower Devonian graptolites from southeastern Alaska: Lethaia, v. 3, no. 2, p. 183-202, illus., 1970.

The youngest known zones of *Monograptus* occur in Devonian black shale and slate of Prince of Wales and Noyes Islands. Five species of the genus, with associated vascular plants and marine shelly faunas, indicate a Praguian, late Lower Devonian age: *yukonensis*, n.sp. aff. *yukonensis*,, *aequabilis notoaequabilis*, *pacificus* Jaeger n.sp., *craigensis* Jaeger n.sp. The *M. yukonensis* zone, with *M. craigensis* in its upper part, is succeeded by the *M. pacificus* zone, which may extend into early Middle Devonian. All known Praguian graptolites belong to *Monograptus*, and the new species increase the number to seven; the broad geographic distributions of *M. yukonensis* and *M. aequabilis notoaequabilis* suggest that the last survivors of the genus were cosmopolitan, with a rather uniform assemblage of species. — VMJ

04399 **Cifelli, Richard.** Age relationships of Mid-Atlantic Ridge sediments, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 47-69, illus., 1970.

Despite the fact that outcrops on the ocean bottom cannot be observed, it is often possible to make meaningful inferences about age relationships of Mid-Atlantic Ridge sediments by paleontologic methods. Data are briefly reviewed here to illustrate the utility of these methods. While data are still few, the inferred age relation-

ships are in general agreement with the models of ridge development recently proposed by van Andel (1968). The pattern of inferred ages suggests an early, active phase of development with tectonism and volcanism prior to late Miocene, followed by a period of quiescence with pelagic deposition during late Miocene and Pliocene, and a final, late eruptive phase, perhaps occurring as late as the Quaternary. — Author's abstract

04010 **Clark, George B.; Rupert, G. B.** Comments on paper by R. F. Favreau, 'Generation of strain waves in rock by an explosion in a spherical cavity' [1969]: Jour. Geophys. Research, v. 75, no. 26, p. 5138-5140, 1970.

For the original paper, *see* ibid., v. 74, no. 17, p. 4267-4280, 1969; Abs. North American Geology, February 1970.

Clark, S. F., Jr. *See* Hatch, N. L., Jr. 04029

03863 **Clark, William B.** Mines and mineral deposits of the Death Valley area, *in* Geologic guide to the Death Valley area, California — Geol. Soc. Sacramento, Ann. Field Trip Guidebook 1970: Sacramento, Calif., Geol. Soc. Sacramento, p. 29-32, illus., 1970.

Best known of the variety of minerals of commercial importance, produced in and around the Valley, is borax. Four other boron minerals have also been found. Gold and silver were the chief attraction to early prospectors, and lead-zinc-silver deposits are widespread, the richest being at Darwin. Substantial amounts of talc have also been produced. — ESL

04424 **Clarke, Garry C.; Classen, David F.** The Fox Glacier Project: Canadian Geog. Jour., v. 81, no. 1, p. 26-29, illus., 1970.

A group of surging glaciers is concentrated in the Alaskan and St. Elias Mts., Yukon. They oscillate between long periods of quiescence and short periods of rapid advance. Since it is impossible to get information on an active glacier, measurements are made on Fox Glacier, which has a history of surging. The Fox is now inactive with maximum flow less than 15 feet per year. Gravity surveys show it to be about 270 feet thick at its thickest; surface area is diminishing, but volume is slowly increasing. Surging may begin when a cold glacier melts at its base and allows sliding. When enough ice has been lost from the accumulation area, the surge stops and the glacier refreezes to the bedrock. Temperatures in the Fox rise gradually from -5.3°C near the surface to -1.8°C at the base, indicating that melting at the base is some years away. — ESL

Classen, David F. *See* Clarke, Garry C. 04424

Clausen, H. B. *See* Johnson, S. J. 04072

Clayton, A. G. *See* Oliver, R. T. 04149

03991 **Cloud, Preston.** Lunar science and planetary history: Science, v. 169, no. 3951, p. 1159, 1970.

The reason for additional Moon landings is that man goes to the Moon to study the Earth and its relations in space. The record of the first billion years of Earth history has been erased by later events; the Moon, however, retains a record of the early stages in the history of the solar system which has profound implications for our understanding of both Earth and solar system and perhaps for the origin and distribution of ore deposits in the older rocks. As a side benefit the results of lunar studies, together with sea-floor geophysics, are pacing a conceptual revolution in the earth sciences. To stop short of achieving our primary scientific goals on the Moon would be one of history's most irresponsible follies. Nothing less than the early institution of a comprehensive automated program to get similar information and sample return could begin to ameliorate such a failure. — DBV

03770 **Coe, Robert S.** The thermodynamic effect of shear stress on the ortho-clino inversion in enstatite and other coherent phase transitions characterized by a finite simple shear: Contr. Mineralogy and Petrology, v. 26, no. 3, p. 247-264, illus., tables, 1970.

The transition of orthoenstatite to clinoenstatite is interpreted to be a coherent polymorphic transition involving a transformation strain of simple finite shear. The rareness with which clinoenstatite is found in naturally deformed terrestrial rocks containing orthoenstatite may mean that the shear stresses are rarely large enough in nature to cross the thermodynamic phase boundary. The orthferrosilite-clinoferrosilite and parawollastonite-wollastonite transitions are thought to be analogous, and similarly large thermodynamic effects of shear stress are predicted. — *from* Author's abstract

03855 **Coffman, Daniel M.** Parameter measurement in fluvial morphology: Indiana Acad. Sci. Proc. 1969, v. 79, p. 333-344, illus., tables, 1970.

Because of the quantitative significance of stream order, an accurate, ordered drainage map has become a base for much research in fluvial morphology. These maps are often prepared from U.S. Geological Survey 1:24,000 topographic maps and doubt is created about their usefulness as sources of primary data. This study indicates that blue lines of such topographic maps by Strahler's method of "V's" does not necessarily result in an accurate drainage map. Relief, age, and geology appear to control the quality of drainage maps which are produced. The relative relief of apparent first-order streams may be used to predict the quality of a drainage map which will be produced from a topographic quadrangle and permits classifications of these quadrangles as excellent, marginal, and unacceptable. — Author's abstract

Cohen, A. *See* Given, P. H. 04091

03783 **Cohen, Arthur D.** An allochthonous peat deposit from southern Florida: Geol. Soc. America Bull., v. 81, no. 8, p. 2477-2482, illus., table, 1970.

An allochthonous beach deposit of peat from southern Florida, studied with the aid of microtome sections, showed the strong microlamination and lack of ingrown roots characteristic of Carboniferous coals. — *from* Author's abstract

04111 **Cohen, T. J.** Source-depth determinations using spectral, pseudo-autocorrelation and cepstral analysis: Royal Astron. Soc. Geophys. Jour., v. 20, no. 2, p. 223-231, illus., 1970.

Interference between P and pP (or P_n and pP_n) in a seismic signal causes the spectrum of the combined wave train to be scalloped with a period equal to the depth-phase delay time. Determination of the null frequency interval, together with a knowledge of the overburden compressional velocity, permits an estimate of the source depth to be made. Scalloping produced by reverberations at the recording station can be reduced by averaging a suite of individual station spectrums. The available spectral bandwidth can be broadened by removing instrument response. To determine objectively the periodicities in the average spectrum, the cepstrum and pseudo-autocorrelation are computed. This combined depth determination method is applied successfully to P_n or P data sets for three underground explosions at known depth. — *from* Author's summary

Coker, D. T. *See* Ottaway, J. M. 04234

04053 **Collins, I. F.** A slip-line field analysis of the deformation at the confluence of two glacier streams [with German and French abs.]: Jour. Glaciology, v. 9, no. 56, p. 169-193, illus., 1970.

Techniques of slip-line theory are used to obtain detailed solutions for deformation at the confluence of one or more tributaries of glacier streams with a main stream and of two main streams. The number, position, and magnitude of bands of intense shear emanating from some of the junction corners are predicted and compared with field data from a confluence on the Kaskawulsh Glacier in the Yukon. In the field exam-

ple, actual flow directions converge markedly just below the confluence probably owing to speeding up of the ice in the medial moraine region as it is freed from the influence of valley walls; this was not predicted by the theoretical model. However, measured direction and magnitude of surface principal strain rates are broadly in agrement with theory. — VSN

Condie, K. *See* Haach, U. 04285

04398 **Cooke, Ronald U.** Morphometric analysis of pediments and associated landforms in the western Mohave desert, California: Am. Jour. Sci., v. 269, no. 1, p. 26-38, illus., tables, 1970.

Fifty-three pediments and their associated mountain areas and alluvial plains were studied in the western Mohave desert. Statistical analysis of the data on gross morphometric properties allows inter-regional and intra-regional comparisons, relating of data to possible 'explanatory' variables and to one another, and testing of some 'explanatory' hypotheses. Similarities and differences among some aspects of pediments and associated landforms in the western Mohave desert and the Sonoran desert are identified. Pediment slope is shown not to be significantly related to pediment length, catchment basin area, or lithology, but it is significantly related to pediment association relief/length ratio. The exhumation hypothesis of pediment development is supported by some arguments based on the anlysis of morphometric data. — *from* Author's abstract

Cooper, L. R. *See* Wallace, D. E. 04130

03970 **Corgan, James H.** Public awareness of earthquakes in Tennessee [abs.]: Tennessee Acad. Sci. Jour., v. 45, no. 2, p. 53, 1970.

Couch, Richard W. *See* Johnson, Stephen H. 04334

04436 **Coughran, Edward H.** Shipboard computers: Oceanology Internat., v. 5, no. 1, p. 28-31, illus., 1970.

Onboard computers reduce sampled data on site. Their capabilities enable dynamic experimentation, permitting users to derive the optimum from on-going experiments. — Author's abstract

Craddock, Campbell. *See* Mooney, Harold M. 04007

04382 **Craddock, Campbell; Mooney, Harold M.; Kolehmainen, Victoria.** Simple Bouguer gravity map of Minnesota and northwestern Wisconsin: Minnesota Geol. Survey Misc. Map M-10, scale 1:1,000,000, separate text, 1970.

The most conspicuous anomaly on the map is the positive feature that trends northward from the Iowa border through the Minneapolis-St. Paul area, comprising the northern part of the Midcontinent Gravity High; two significant bends in the anomaly are apparent. The gravity high bifurcates in northwestern Wisconsin where it gives way to a nearly circular gravity low centered on the Bayfield peninsula. Along most of its extent south of Lake Superior the High is flanked by linear gravity lows that define significant sedimentary basins. Central Minnesota is marked by a belt of high-gravity values about 100 miles wide that trends WSW from the edge of the Keweenawan province. The most prominent Bouguer anomaly low lies immediately north of and parallel to the Mesabi range. Gravity anomaly patterns in northwestern Minnesota are difficult to interpret because so little is known about bedrock geology. — MCM

Cremer, Marcelyn. *See* Gulbrandsen, R. A. 04254

04374 **Cress, Glynn.** Ohm's law and rock samples, a plane complex convenience: Mines Mag., v. 60, no. 6, p. 9-10, illus., 1970.

The method for determining the resistivity of semi-conductor discs of otherwise arbitrary shape, developed by L. J. van der Pauw (1958) is discussed in relation to its application to core sample analysis. In this application the method requires measurement of the disc thickness, and two voltage and two current measurements. A development of the mathematics on which the method is based is presented to help explain its limitations and assumptions. The mathematical model shows that the sample must be thin (the thickness should not be more than 1/5 the diameter) and macroscopically homogeneous. The method is simple, reliable, fast and inexpensive. — GV

03857 **Cressman, Earle R.; Karklins, Olgerts L.** Field trip No. 2, Lithology and fauna of the Lexington Limestone (Ordovician) of central Kentucky, *in* Guidebook for field trips — Geol. Soc. America, Southeastern Sec., 18th Ann. Mtg., Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, p. 17-28, illus., 1970.

The bryozoan zonation of the Lexington Limestone is discussed by Karklins, and other aspects by Cressman. Members of the Lexington Limestone are intertonguing calcilutites, calcirudite, calcarenite, bedded limestone with lenses and nodules of different types and various invertebrate fossils, interbedded shales, and brachiopod coquina — each indicative of specific marine environments of deposition, interpreted in terms of transgression and regression. On this trip emphasis is on the lithic character of the stratigraphic units, seen at 5 stops. The Lexington Limestone is divided into two biostratigraphic units on the basis of listed Middle and Upper Ordovician bryozoan assemblages, designated A and B in ascending order, which can be recognized laterally away from the reference section. — GDC

Crocket, James H. *See* Keays, Reid R. 04417

Crowl, G. H. *See* Frankel, L. 04097

04180 **Cserna, Zoltan de; Rincón Orta, Cesar; Solorio-Munguía, Jose; Schmitter-Villada, Eduardo.** Una edad radiométrica Pérmica temprana de la región de Placer de Guadalupe, noreste de Chihuahua [An early Permian radiometric age for the Placer de Guadalupe area, northeastern Chihuahua]: Soc. Geol. Mexicana Bol. 1968, v. 31, no. 1, p. 65-73, illus., table, 1970.

In the Placer de Guadalupe region in the Sierra de Plomosas of northeastern Chihuahua, between the uppermost Permian fossiliferous beds (Wolfcampian) and the lowest Upper Jurassic beds, a sequence of 600 m of fine-to-coarse clastics with an extrusion of rhyolite is found which contains two unconformities of unknown age. A rhyolite sample, collected from the extrusion, which lies 300 m from the base of the clastic sequence, was used to obtain a Pb-alpha age determination on zircon. The age of 270 ± 30 m.y. which corresponds to Lower Permian, is significant for the lower half of the sequence, while the upper half can be considered as Permian, Triassic or Tertiary in age. — *from* Authors' abstract

Cukor, P. *See* Lublin, P. 04128

Cumming, George L. *See* Folinsbee, Robert E. 03923

04255 **Curtin, Gary C.; Lakin, Hubert W.; Hubert, Arthur E.** The mobility of gold in mull (forest humus layer), *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C127-C129, illus., tables, 1970.

Three gold-bearing samples of mull were leached with demineralized water. The leachate from the first sample was passed through a 0.45-micron average pore diameter membrane filter. The remaining two leachates were passed through 0.05-micron average pore diameter membrane filters. The filtered leachates contained 110, 27, and 120 parts per trillion (1×10^{-12}) gold, respectively. The relatively high gold content of two of the leachates suggests that in the mull layer of the soil, gold is slightly mobile principally as extremely small colloidal particles (<0.05 micron diameter) and in minor amounts as gold cyanide and gold thiocyanate ions. — Authors' abstract

Curtis, Garniss H. *See* Savage, Donald E. 04387

04250 **D'Agostino, John P.; Hanshaw, Penelope M.** Malachite- and specularite-bearing Triassic sandstone localities near Chantilly, Virginia, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C103-C106, illus., table, 1970.

A zone of gray sandstone in predominantly red Triassic beds, in a pipeline trench exposure near Chantilly, Fairfax County, Va., contains noticeable malachite and azurite. A specularite-bearing conglomeratic sandstone containing minor malachite was noted about 1 mile southeast of the copper locality in a housing-development excavation near a diabase intrusion. At the first locality, all mineralization is secondary and is not in contact with diabase. Semiquantitative spectrographic analyses showed as much as 20,000 ppm copper and 50 ppm silver. Similar mineralized rock has been economically important in the past elsewhere in Triassic rocks of the eastern United States and conceivably could become so again in the future. — Authors' abstract

Dahlberg, Eric C. *See* Rose, Arthur W. 04310

04314 **Dahlberg, Eric C.** Generalized Bayesian classification functions, K classes — Discussion [of paper by K. Wignall, 1969]: Econ. Geology, v. 65, no. 2, p. 220-221, 1970.

The paper discussed here (ibid., v. 64, p. 571-574, 1969) was cited in Abs. North American Geology, April 1970.

03851 **Daily, Fay Kenoyer.** Some charophytes from the Pleistocene [abs.]: Indiana Acad. Sci. Proc. 1969, v. 79, p. 84, 1970.

03920 **Damon, Paul E.** A theory of "real" K-Ar clocks, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 69-76, illus., 1970.

A good approximation to diffusional losses in minerals can be obtained by use of the concept of an escape constant (which is analogous to the radioactive decay constant). In this way Ar-40 can be treated as if it were a radioactive daughter product of K-40. With this concept, a theory of "real" K-Ar clocks can be developed. The "real" K-Ar clock is treated as a more or less open system in the presence of an external environment containing a significant partial pressure of Ar-40. The equation of the "ideal" K-Ar clock is one of five special cases which can be derived from the more general equation of the "real" K-Ar clock. — GV

03935 **Daniels, R. B.; Gamble, E. E.; Cady, J. G.** Some relations among coastal plain soils and geomorphic surfaces in North Carolina: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 648-653, illus., 1970.

On the upper and middle coastal plain of North Carolina, soils have been exposed to soil forming processes for several million years, yet a process such as gibbsite formation may have been in operation for only a small percentage of the time. Once a process begins, the amount of change per unit of time usually is not linear. — Soil brief

03990 **Daniels, R. B.; Nelson, L. A.; Gamble, E. E.** A method of characterizing nearly level surface [with French and German abs.]: Zeitschr. Geomorphologie, v. 14, no. 2, p. 175-185, illus., tables, 1970.

A field technique for measuring the microrelief of nearly level surfaces is described which is simple enough for one man to make the required measurements, using a hand level for elevation control and pacing for distance; in addition certain statistical considerations must be used. The stepped sequence of levels characterizing the Neuse-Cape Fear and Neuse-Tar interstream divides in North Carolina were differentiated using the method. — VSN

Danilchik, Walter. *See* Rogers, C. L. 04246

Dansgaard, W. *See* Johnson, S. J. 04072

03822 **Darrell, James H., 2d; Hart, George F.** Environmental determinations using absolute miospore frequency, Mississippi River delta: Geol. Soc. America Bull., v. 81, no. 8, p. 2513-2518, illus., tables, 1970.

Samples of modern sediments were collected from the main depositional environments of the Mississippi River delta according to a predetermined sampling pattern designed to determine if: (a) differences could be detected among environments, and (b) which environments showed differences. The data were analyzed using a nested analysis of variance test and orthogonal comparisons. Significant differences do exist, but are not large enough to be clearly definitive of a particular environment. — Author's abstract

David, David. *See* Komornik, Amos. 04225

04293 **David, Michel.** Geostatistical ore estimation, a step-by-step case study [abs.]: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 447, 1970.

04191 **Davidson, A.** Precambrian geology, Kaminak Lake map-area, District of Keewatin (55L): Canada Geol. Survey Paper 69-51, 27 p., illus., tables, geol. map, 1970.

In the southern half of the Kaminak Lake map-area, in the barren grounds west of Hudson Bay, occur old metamorphosed volcanic and sedimentary rocks, the Kaminak Group, and a series of plutons, all probably Archean. They are cut by diabase dikes and overlain by sedimentary and volcanic rocks of the Hurwitz Group. To the northwest older rocks are overlain by MacKenzie Lake metasediments and the whole succession is deformed and metamorphosed to amphibolite facies of low pressure type. The northern part contains gneiss and migmatite formed from the Kaminak Group, plutonic rocks, MacKenzie Lake metasediments, and some new granitic material. Metamorphism of pre-Hurwitz diabase dikes outlines the approximate southern extent of later Hudsonian metamorphism. Numerous gossans occur in metavolcanic rocks of the Kaminak Group. — *from* Author's abstract

04447 **Davidson, A.** Nepheline-K-feldspar intergrowth from Kaminak Lake, Northwest Territories: Canadian Mineralogist, v. 10, pt. 2, p. 191-206, illus., tables, 1970.

Results of electron probe micro-analysis of vermiform nepheline-K-feldspar intergrowth in alkalic rocks from Kaminak Lake, N.W.T., indicate chemical equivalence of the intergrowth to leucite containing 39 weight per cent soda-leucite. Mechanisms of origin are discussed, and formation by cotectic crystallization of nepheline and K-feldspar is suggested. — Author's abstract

Davies, J. A. *See* Ottaway, J. M. 04234

04309 **Davis, J. B.; Kirkland, D. W.** Native sulfur deposition in the Castile formation, Culberson County, Texas: Econ. Geology, v. 65, no. 2, p. 107-121, illus., tables, 1970.

Deep-seated native sulfur deposition in Rustler Springs sulfur district of west Texas is characterized by a deposit consisting of calcite with up to 25 percent elemental sulfur in the Permian Castile Formation at a depth of 666-735 feet. The epigenetic nature of the deposit is evidenced by its stratigraphic equivalence to the Castile anhydrite in nearby sections. The δC^{13} values of -24.1 and -38.0 percent for epigenetic calcite and of +6.7 percent for sulfur, compared with +26.6 percent for associated anhydrite, indicate a biogenic origin. As solution porosity developed in the anhydritic Castile Formation, oil migrated into certain regions. Sulfate-reducing bacteria generated large quantities of hydrogen sulfide and carbon dioxide. Calcite precipitated and eventually oxygenated ground waters mixed with the hydrogen-sulfide rich waters leading to oxidation of hydrogen sulfide and deposition of sulfur. — *from* Authors' abstract

04023 **Deep Sea Drilling Project.** (Scientific staff). Deep Sea Drilling Project — Leg 11: Geotimes, v. 15, no. 7, p. 14-16, illus., table, 1970.

On this leg, holes were drilled at 11 sites in the western North Atlantic. Two principal objectives were pursued: to recover the oldest in-place material above the oceanic crust, and to determine the processes involved in construction of the massive accu-

mulations of sediment forming the continental rise and outer ridges. Brief descriptions of cores from Sites 98-105 are given. Site 98 is in the Northeast Providence Channel in the Bahama Banks, the next six sites along the Blake-Bahama Outer Ridge system, and the balance along the base of the continental rise as far north as New Jersey. Several cores showed a major hiatus where sediment changes from Lower Cretaceous to Oligocene-Miocene. — ESL

DeFazio, Thomas. *See* Aki, Keiiti. 04337

03988 **DeGeoffroy, J.; Wu, S. M.; Heins, R. W.** Some observations on springs in southwest Wisconsin: Water Resources Research, v. 6, no. 4, p. 1235-1238, illus., tables, 1970.

This study follows two papers (DeGeoffroy, et al., 1967, 1968) that describe a spring-sampling technique used to detect zinc ore bodies in Wisconsin. It was discovered that valuable hydrologic data could be collected simultaneously. Samples from 7,210 springs were collected in an area of 900 sq mi. Most springs occur along shale outcrops or joints. The study is concerned mainly with regional variations of pH, hardness, and iron content. Iron increases from west to east as pH decreases. The system of synclinal folds that controls sulfide deposition is followed by ridges of iron readings. — ESL

04282 **DeGeoffroy, J.; Wu, S. M.** A statistical study of ore occurrences in the greenstone belts of the Canadian Shield: Econ. Geology, v. 65, no. 4, p. 496-504, illus., tables, 1970.

The Northwest Quebec-Northeast Ontario mineral belt is chosen as a control area for a study of the mineral potential of the greenstone belts of the Canadian Precambrian Shield. A statistical study of the ore occurrences in the control area is presented in three aspects: (1) areal distribution which is closely fitted by a negative binomial model, (2) value distribution fitted by a log-normal model, and (3) correlation between the areal and value distributions. By projecting the results of this study to the remaining greenstone areas of the Shield, two predictions of the mineral potential of the Shield are made: (1) a preliminary estimate of 1,478 ore deposits worth 84,682.9 million dollars on the basis of 1968 metal prices, and (2) a more realistic prediction based on present economic conditions which includes 493 ore deposits worth 53,047.5 million dollars. — Authors' abstract

04432 **DeGeoffroy, J.; Wu, S. M.** Design of a sampling plan for regional geochemical surveys: Econ. Geology, v. 65, no. 3, p. 340-347, illus., tables, 1970.

A sampling plan is designed for the purpose of reducing the cost of regional geochemical surveys while keeping the thoroughness of the coverage at an acceptable level. The design of the plan is based on statistical methods in conjunction with geological and geochemical considerations. The plan allows several options which depend on the order of priority given to the thoroughness of the survey and to the cost of the coverage. One of these options is the "maximum gain" plan. If this plan is applied to the Upper Mississippi Valley zinc-lead district, for example, we can expect to detect 76 percent of the geochemical targets sought, for a coverage of 50 percent of the district. The application of a similar sampling plan to other mining districts is also suggested. — Authors' abstract

Delabio, R. N. *See* Wanless, R. K. 04096

04155 **Delevoryas, T.; Hope, R. C.** Contributions to our knowledge of Triassic Cycadales [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 758, 1970.

04009 **DeLory, F. A.; Salvas, R. J.** Some observations on the undrained shearing strength used to analyze a failure — Reply [to 1970 discussion by J. D. Brown of 1969 paper]: Canadian Geotech. Jour., v. 7, no. 3, p. 345-346, illus., table, 1970.

The original paper was published, ibid., v. 6, no. 2, p. 97-110, 1969; *see* Abs. North American Geology, February 1970. This reply follows the discussion by Brown (ibid., v. 7, no. 3, p. 343-344). — GDC

Denson, N. M. *See* Izett, G. A. 04259

04319 **Desborough, George A.** Silver depletion indicated by microanalysis of gold from placer occurrences, Western United States: Econ. Geology, v. 65, no. 3, p. 304-311, illus., 1970.

Quantitative electron microprobe analysis and mineragraphic study of placer gold grains from 24 localities in the Western United States, including Alaska, reveals that a microscopically visible low-silver rim is developed on most grains. This effect is probably produced by low-temperature, oxidizing aqueous solutions that preferentially remove silver. The original or primary composition of the gold grains is generally preserved in the interior as are sulfide inclusions. This preservation of the primary composition on the interior of gold grains may afford an opportunity to determine the lode source of the placer grains if they have not undergone homogenization after primary deposition. — Author's abstract

04075 **deWit, M. J.** Evidence for salt deposits in the Appalachian/Caledonian orogen: Nature, v. 227, no. 5260, p. 829-830, illus., 1970.

The large amounts of Na_2O involved in the albite schists which occur abundantly in the Eocambrian to Lower Ordovician metasediments along the entire metamorphic Caledonian-Appalachian mountain chain may have been derived from evaporites and related sediments which were a major early component of thick sediment wedges along the proto-Atlantic continental margin. Such evaporites may remain on a descending ocean plate, like the Arabian Shield evaporites, or in conditions of orthotectonic deformation and metamorphism may undergo complex reactions with silicates to give rise to albite oligoclase schists and to the sometimes widespread developments of scapolite. — DBV

04294 **Dibbs, H. P.** The application of neutron activation analysis to the determination of copper in minerals: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 493-499, illus., tables, 1970.

An account is given of the application of neutron activation analysis to the rapid, non-destructive determination of copper in minerals, using a 14-MeV neutron source. Elements that interfere in the determination of copper by this method are given, together with the errors in the estimation of copper that result from the presence of varying amounts of these elements. The possible use of a compact "sealed-tube" 14-MeV neutron generator for the field assay of copper in minerals is discussed. — Author's abstract

03963 **Dietz, Robert S.; Holden, John C.** Reconstruction of Pangaea — Breakup and dispersion of continents, Permian to present: Jour. Geophys. Research, v. 75, no. 26, p. 4939-4956, illus., 1970.

A new continental drift reconstruction of Pangaea in the Permian is presented, plus a series of five world maps depicting the breakup and dispersion of continents with each subsequent geologic period from Triassic to Recent. The reconstruction is based on plate tectonics and sea-floor spreading, the morphologic fit of continental margins, and paleomagnetic data. The ocean floor is essentially all Mesozoic or younger; even the basins behind island arcs appear to be neo-oceanic regions. Paleozoic ocean floor may exist in the Canadian basin of the Arctic Ocean or off the Pacific margin of West Antarctica. The crustal plates with their included continents have a history of mostly northward and westward displacement. The trenches have tended to remain fixed while the rifts have migrated, so that the plates have changed in size. — DBV

03956 **Dobbins, David A.; Ragland, Paul C.; Johnson, J. Donald.** Water-clay interactions in North Carolina's Pamlico estuary: Environmental Sci. and Technology, v. 4, no. 9, p. 743-748, illus., tables, 1970.

Pore to bottom water ratio of cationic equivalents measured at 20 stations increases systematically downstream from about 0.6 to 1.2 along a 50-mile profile in the Pamlico River estuary, a trend controlled by entrapment of relatively saline water after northeasterly storms as the suspended load settles. Cationic concentrations generally

decrease in pore waters with depth, from a maximum 10-20 cm beneath the sediment-water interface. Because top portions of cores are from a zone of active sediment-water mixing, and cores were taken at a time of near maximum salinity in bottom waters, pore water from deeper portions of cores may reflect long-term mean salinities. An increase of K equivalent ionic fraction in the pore waters with depth may be related to H^+ ion exchange with sediments. A strong correlation between exchangeable Mg and chlorite, as well as exchangeable K and illite, was noted. — *from* Authors' abstract

Dodson, Martin H. *See* Rex, David C. 03919

Doe, Bruce R. *See* Peterman, Zell E. 03826

03921 **Doe, Bruce R.** Evaluation of U-Th-Pb whole-rock dating on Phanerozoic sedimentary rocks, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 79-82, illus., table, 1970.

Additional studies on the feasibility of dating limestones deposited from epeirogenic seas were not successful. The Ph-206/Pb-204 — U-238/Pb-204 isochron was most likely destroyed by fairly recent alterations in U/Pb. The Pb-207/Pb-204 — Pb-206/Pb-204 secondary isochron more closely reflects the age of the source area of the sediments than the age of sedimentation. — Author's abstract

Donnelly, Thomas W. *See* Murphy, Andrew J. 03829

03887 **Dorrzapf, Anthony F., Jr.; Brown, Floyd W.** Direct spectrographic analysis for platinum, palladium, and rhodium in gold beads from fire assay: Appl. Sectroscopy, v. 24, no. 4, p. 415-418, tables, 1970.

Platinum, palladium, and rhodium are determined by direct spectrographic analysis of a 4 mg gold bead obtained by fire assay fusion and cupellation. The weighed bead is placed into a graphite electrode containing 2 mg of $(NH_4)_2OsCl_6$ which stabilizes the platinum volatilization and is burned in a 15 A dc arc in an argon-oxygen atmosphere. Detection limits for a sample of one assay ton are 5 ppb for Pt and less than 1 ppb for Pd and Rh. — Authors' abstract

04193 **Douglas, A. G.; Douraghi-Zadeh, K.; Eglinton, G.; Maxwell, J. R.; Ramsay, J. N.** Fatty acids in sediments including the Green River Shale (Eocene) and Scottish Torbanite (Carboniferous), *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 315-334, illus., tables, 1970.

The above authors have recently reported (Eglinton et al., 1966) the occurrence of isoprenoid phytanic and norphytanic acids in the Green River Shale and here report extension of this series from C-14 to C-21 (except for C-18 acid). Samples were from the 1100- and 1900-ft levels at Sulphur Creek. "Free" fatty acids in samples from the 1100- and 1900-ft levels and total fatty acids (1100-ft) in mg/100 g shale were 4.8, 1.5, 65.0, respectively; range of n-acids in total fatty acids was C-13 to C-32 (mass spectrometry) or C-12 to C-34 (gas chromatograms), and of isoprenoid acids in total fatty acids, C-14 to C-21. In the Torbanite examined, the range of normal acids was from C-10 to C-28 with marked dominance of C-16 and C-18 acids. In the total fatty acids, range of normal acids extended from C-9 to C-21. Questions posed by results are examined. — VSN

Douraghi-Zadeh, K. *See* Douglas, A. G. 04193

04055 **Drake, J. J.; Ford, D. C.** Distorted ice stalactites as indicators of glacier movement: Jour. Glaciology, v. 9, no. 56, p. 286-287, illus., 1970.

Distorted ice stalactites, observed in an ice cave at the snout of a small temperate glacier in the Mt. Castleguard area, Alberta, are thought to have been pulled out of vertical orientation by ice movement. The 'stretched' stalactites are believed to be 3-4 times longer than their original vertical form and to reflect 30 cm of glacier movement. — VSN

04329 **Drew, David P.** The significance of percolation water in limestone catchments: Ground Water, v. 8, no. 5, p. 8-11, illus., table, 1970.

Studies of limestone hydrology have largely ignored the possible significance of water flowing outside of major conduits, which is designated as "percolation water." Its importance in an area is probably a function of rock type, structure, and hydrologic characteristics. Experiments in England and Jamaica, which traced percolation water with the dye Pyranine Conc, suggest longer flow-through times than for water sinking at discrete points on the surface (allogenic water). The soil cover in an area may be responsible in part for this delay. Results from traces of percolation water may be used to compile isochronal maps of limestone catchments. — *from* Author's abstract

03993 **Drummond, A. H., Jr.** Mastodons at sea: Sea Frontiers, v. 16, no. 3, p. 151-153, illus., 1970.

Occurrences of mastodon and mammoth teeth and bones and associated land animal and plant fossils in late Pleistocene deposits of the Atlantic continental shelf, from Georges Bank east of Cape Cod to the Virginia coast, are summarized in a popular account. The entire area was a sandy plain above sea level from about 25,000 to 11,000 years ago. — VMJ

04266 **Dudley, W. W., Jr.** Nonsteady inflow to a chamber within a thick aquitard, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C206-C211, illus., tables, 1970.

Nuclear devices for underground testing must often be kept dry in chambers excavated in rocks of low permeability thousands of feet beneath the water table. For calculating the time-variable discharge to such a chamber, the chamber interval is arbitrarily treated as an aquifer, although the entire zone actually is an aquitard. Those parts of the aquitard above and below the chamber interval are treated as leaky confining beds. Combining the upper and lower recharge systems into a hydraulically equivalent system with only one recharge source allows the application of a type-curve method developed by Hantush for the constant-drawdown, leaky artesian inflow to a well. — Author's abstract

Dulekoz, Erhan. *See* Brookins, Douglas G. 04112

Duncan, James M. *See* Chang, Chin-Yung. 04220

04221 **Duncan, James M.; Chang, Chin-Yung.** Nonlinear analysis of stress and strain in soils: Am. Soc. Civil Engineers Proc., v. 96, paper 7513, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1629-1653, illus., table, 1970.

A simple, practical procedure for representing the nonlinear, stress-dependent, inelastic stress-strain behavior of soils was developed. The values of the required parameters employed in the stress-strain relationship may be derived from the results of standard triaxial tests on plane strain compression tests involving primary loading, unloading, and reloading. Comparisons of calculated and measured strains in specimens of dense and loose silica sand showed that the relationship was capable of accurately representing the behavior of this sand under complex triaxial loading conditions, and analyses of the behavior of footings on sand and clay showed that finite element stress analyses conducted using this relationship were in good agreement with empirical observations and applicable theories. — ASCE abstract

04227 **Duncan, James M.; Dunlop, Peter.** Slopes in stiff-fissured clays and shales — Closure [to discussion of paper 6449, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1795-1799, illus., 1970.

Paper 6449 (ibid., v. 95, no. SM2, p. 467-492, 1969) was cited in Abs. North American Geology, September 1969, and discussion by R. N. Chowdhury, R. Richards, Jr., and D. F. Coates (ibid., v. 96, no. SM1, p. 336-344, 1970) in June 1970.

Dunlop, Peter. *See* Duncan, James M. 04227

Dutcher, R. R. *See* Vastola, F. J. 04093

04154 **Eargle, D. Hoye.** Uranium in Texas: Houston Geol. Soc. Bull., v. 13, no. 2, p. 18-27, illus., 1970.

Five geographic areas of Texas where at least some uranium has been found are listed, the nature of the mineralization summarized, and their potential considered briefly. The areas are: Trans-Pecos; Panhandle, in Triassic sandstones and conglomerates filling channels; Red River region, in channels and carbonaceous sandstones in outcrops of Permian redbeds, potential low; Llano Uplift, little prospecting done, potential seems low; and Coastal Plain, the only area in which economic deposits have been exploited. These deposits are in Tertiary beds extending from Fayette County in east-central Texas to Starr County on the Rio Grande, but principal deposits are in Karnes County. Several prospects and mines are described. Current exploration is by boring, logging, and core sampling. Many anomalies are found along faults, discovered by photointerpretation. — ESL

Earl, J. L. *See* Chow, T. J. 04082

03972 **Eason, J. E.; Bergenback, R. E.** Reflections on the significance of crossbedding in ancient sandstones [abs.]: Tennessee Acad. Sci. Jour., v. 45, no. 2, p. 53, 1970.

Eaton, Gordon P. *See* Ericksen, George E. 03818

03975 **Eaton, J. P.; Lee, W. H. K.; Pakiser, L. C.** Use of microearthquakes in the study of the mechanics of earthquake generation along the San Andreas fault in central California, *in* Earthquake mechanics (T. Rikitake, editor), a symposium, Madrid, Spain, 1969: Tectonophysics, v. 9, nos. 2-3, p. 259-282, illus., 1970.

The National Center for Earthquake Research of the U.S. Geological Survey has been studying the San Andreas fault in central California to develop microearthquake mapping techniques for use in study of earthquake mechanisms. Studies have included use of a small, dense network of portable seismograph stations in the area of the 1966 Parkfield-Cholame earthquake and in the actively creeping section of the San Andreas fault south of Hollister in 1967, and a continuing study with a permanent telemetered network along the San Andreas, Hayward, and Calaveras faults between Hollister and San Francisco. Results are discussed, and indicate that focal depths are limited to 15 km or less; few are deeper than 12 km. There appears to be a transition from "granitic" rocks of the upper crust to gabbroic rocks of the lower crust at these depths. — VSN

04420 **Eaton, J. P.; O'Neill, M. E.; Murdock, J. N.** Aftershocks of the 1966 Parkfield-Cholame, California, earthquake — A detailed study: Seismol. Soc. America Bull., v. 60, no. 4, p. 1151-1197, illus., tables, 1970.

Hypocenters and magnitudes of more than 600 aftershocks of the 1966 Parkfield-Cholame earthquake were determined from recordings of a dense network of portable stations operated in the epicentral region from 3 to 82 days after the main shock. Hypocenters were virtually confined to a nearly vertical zone extending from the surface to a depth of 12 to 14 km. Aftershocks were concentrated in patches on the slip surface, with many events at 2 to 4 km and 8 to 10 km and relatively few at 5 to 7 km. Simple, nearly horizontal right-lateral strike-slip displacement appears to have been the source of an overwhelming majority of aftershocks. The coefficient "b" in the frequency-magnitude equation appears to be depth-dependent. Stations with consistently late P-wave arrivals also recorded abnormally large amplitudes, both anomalies apparently increasing with increasing thickness of sediments at the site. — *from* Authors' abstract

Eberlein, G. Donald. *See* Churkin, Michael, Jr. 03873

03941 **Eden, W. J.; Mitchell, R. J.** The mechanics of landslides in Leda clay [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 285-296, illus., table, 1970.

An appraisal of the drained shear strength of Leda clay under low effective normal stresses has resulted in a new appreciation of its behavior in this stress range which can be applied to consideration of the stability of slopes. Closely spaced planes of

weakness existing in the apparently intact clay give rise to dilatant behavior and predominantly frictional shearing resistance. This mode of failure is consistent with field observations [in the Ottawa area] that have been compiled from numerous landslides; three of these landslides are analyzed in this paper. — Authors' abstract

Eden, W. J. *See* Jarrett, P. M. 03944

Eden, W. J. *See* Penner, E. 03945

04001 **Edgerton, Harold E.** Seismic profiling with sonar: Oceanology Internat., v. 5, no. 8, p. 22-24, illus., 1970.

Seismic surveying uses strong pulses of sound, whose waves are reflected and refracted by the area being investigated. Results are deduced by analyzing arrival times of returning waves. The seismic profiler was adapted from the depth finder to study the ocean bottom. The first signal to be received is the direct signal; then the bottom signal is received followed by sub-bottom echoes from sediment layers, and from the rock basement. Watching the change in time of arrival of reflections as the ship moves helps identify the reflectors. Reflections may cause a second trip to the bottom and interpretations of these echoes may be erroneous. Vertical-beam and side-scanning sonar systems are described. — ESL

Eglinton, G. *See* Douglas, A. G. 04193

Ehmann, W. D. *See* Rebagay, T. V. 04268

04378 **Ehrlich, M.** Unique geophysical seismic tool: Mining in Canada, July 1970, p. 25-28, illus., 1970.

The process of continuous Marine Sub-Bottom Reflection Profiling is discussed in terms of its application to marine problems, its advantages and its shortcomings. Results obtained using this type of seismic investigation in various geologic settings are discussed. — GV

03819 **Elliot, David.** Determination of finite strain and initial shape from deformed elliptical objects: Geol. Soc. America Bull., v. 81, no. 8, p. 2221-2236, illus., tables, 1970.

Simple and general equations relating the initial and deformed shape and orientation of elliptical particles are derived by considering the matrix algebra. A shape factor grid enables accurate calculation of the magnitude and orientation of the strain ellipse. A variety of important initial distributions can be determined and used. — AG

Ellis, Robert M. *See* Ishii, Hiroshi. 04400

Ellis, W. R. *See* Wiebenga, William A. 03986

04354 **Elsik, William C.** Palynology of a Paleocene Rockdale lignite, Milam County, Texas — [Pt.] 3, Errata and taxonomic revisions: Pollen et Spores, v. 12, no. 1, p. 99-101, 1970.

Corrections are listed for Pts. 1 and 2, "Morphology and taxonomy," of this paper (Elsik, ibid., v. 10, no. 2, p. 263-314, 1968; no. 3, p. 599-664, 1968), and the following taxonomic revisions are made: *Schizosporis paleocenicus* Elsik, 1968 is tentatively referred to an angiosperm natural genus, becoming *Annona* (?) *paleocenicus* (Elsik, 1968), n. comb. The specimen designated by Elsik (1968) as *Pterocarya* sp. is referred to *Engelhardtia tenuipolus* (Anderson, 1960) Elsik, 1968. Description of the genus *Brevicolporites* (Anderson, 1960) is emended from syncolpate pollen to "oblate to spherical, tricolporate pollen bearing faint to conspicuous arci"; presence of arci link this genus to angiosperm pollen of *Alnus*- and *Ulmus*-types. *Phaseoliidites stanleyi* Elsik, 1968 is referred to *Brevicolporites*. — VMJ

Elwell, J. H. *See* Simon, D. E. 04451

04138 **Embree, Glenn F.** Lateral and vertical variations in a Quaternary basalt flow — Petrography and chemistry of the Gunlock flow, southwestern Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 1, p. 67-115, illus., tables, geol. map, 1970.

The Gunlock basalt flow shows insignificant lateral chemical variation. Vertically there is decrease in SiO_2, Na_2O, K_2O, MgO, FeO, U, and Th and increase in CaO near the top of the flow; CaO, MgO, and FeO locally are minimal near the center, and Na_2O, K_2O, U, and SiO_2 possibly decrease near the base. Modal variations are slight, but plagioclase appears to decrease upward. Flowage differentiation, post-emplacement volatile escape of alkalies and SiO_2, and differential diffusion of ions in the melt are possible causes of the observed chemical and modal variations. Primary oxidation of Fe-Ti oxides is most intense in the lower two-thirds of the flow and reflects temperature distribution in the cooling flow; stability fields of rutile-titanohematite and rutile-pseudobrookite-titanohematite exist at about 700°C. — *from* Author's abstract

04122 **Emery, Philip A.** Electric analog model evaluation of a water-salvage plan, San Luis Valley, south-central Colorado: Colorado Water Conserv. Board Ground-Water Ser. Circ. 14, 11 p., illus., table, 1970.

An electric analog model is used to synthesize hydrology of the San Luis Valley and to predict effects of changes in water management. The plan called for salvaging water being consumed by nonbeneficial vegetation in the central valley (closed basin) by pumping a network of wells. The model was used to predict effects of pumping annually about 84,000 acre-feet of water from 129 wells for a 50-yr period. Predicted decline in ground-water levels ranged from 1-100 feet; outside of the designated area, the decline was generally less than 10 feet. The major part of the water pumped is derived from salvaged ground water that otherwise would have been lost to nonbeneficial evapotranspiration (84 percent) and the remainder is from ground-water storage (14 percent) and the Rio Grande (2 percent). — *from* Author's abstract

03939 **Emilia, David A.; Bodvarsson, Gunnar.** More on the direct interpretation of magnetic anomalies (reply to M. H. P. Bott and M. A. Hutton) [of 1969 discussion of 1969 paper]: Earth and Planetary Sci. Letters, v. 8, no. 4, p. 320-321, 1970.

The comments of Bott and Hutton (ibid., p. 317-319, 1970) are justified since certain unique aspects of the problem were not discussed in the original paper (ibid., v. 7, p. 194-200, 1969; Abs. North American Geology, June 1970). — HRC

04272 **Epp, David; Grim, Paul J.; Langseth, Marcus G., Jr.** Heat flow in the Caribbean and Gulf of Mexico: Jour. Geophys. Research, v. 75, no. 29, p. 5655-5669, illus., tables, 1970.

Eighty-seven new heat-flow values have been obtained in the Caribbean Sea and Gulf of Mexico. Caribbean values are generally uniform. Above-average flow is found in Cayman trough and Yucatan basin; excess flux may represent energy released during shear at the boundary between Caribbean and Atlantic crustal plates. Data are insufficient on the heat-flow pattern in the Antilles Island arc; it is below-average east of it and above-average west of it. Average heat flow in the Venezuelan basin is close to that for all ocean basins; values in the Colombia basin trend from below average in the east to above average in the west, and are uniformly low through most of the Gulf of Mexico. A decrease of temperature gradient with depth in the sediment is characteristic of most Gulf measurements. Uniformly high heat flow in the area of knolls supports the hypothesis that it is underlain by salt structures. — DBV

03818 **Ericksen, George E.; Wedow, Helmuth, Jr.; Eaton, Gordon P.; Leland, George R.** Mineral resources of the Black Range Primitive area, Grant, Sierra, and Catron Counties, New Mexico: U.S. Geol. Survey Bull. 1319-E, p. E1-E162, illus., tables, geol. map, 1970.

No commercial or potentially commercial mineral deposits were found in the Black Range Primitive area; it is unlikely that any exist in the volcanic rocks of the Datil Formation that underlie most of the area. Nearby areas contain exploited mineral

deposits in Precambrian, Paleozoic, and lower Tertiary rocks; on the basis of present knowledge, it is impossible to designate Black Range areas most likely to have hidden ore deposits in older rocks. Because of extent of volcanism and faulting, it is unlikely that oil and gas occur in Paleozoic sedimentary rocks. Although minable metallic and nonmetallic mineral deposits are known to occur in the Datil Formation elsewhere in southwestern New Mexico, they appear to be absent in this primitive area. — *from* Authors' conclusions

04032 **Erickson, A. Kirth.** Structural origin of the Nesson and Antelope anticlines, North Dakota: Compass, v. 47, no. 3, p. 134-140, illus., 1970.

The Nesson anticline is a broad north-south trending structural nose on the north slope of the Williston basin. It is interpreted to be the surficial expression of a northeast-trending Precambrian high which was segmented and displaced by northwest-trending, left-lateral, en echelon wrench faults. The Antelope anticline in McKenzie County, projects from the Nesson anticline like a thumb pointing to the southeast. It is interpreted to be a drag fold resulting from lateral compression and deformation of a crustal block which is bounded on three sides by left-lateral wrench faults, and wedged between crustal blocks on either side. A cross fault terminates the block on the south and bends northwestward at the terminus of the fold to form the southwest boundary of the block. Forward motion of the block is opposed and retarded at the curve in the terminating wrench fault resulting in an asymmetrical drag fold. — *from* Author's abstract

04000 **Erickson, Bruce R.** The colossal lizard, mosasaur: Mus. Observer, v. 6, no. 2, p. 2-6, illus., 1970.

The mosasaur, an ocean-living creature with flippers instead of legs, was a contemporary of the last dinosaurs, and its range was world-wide. Mounting of a skeleton in the Science Museum, St. Paul, Minn., is described, including the various bones and their relation to each other. — ESL

Erickson, J. Mark. *See* Stone, William J. 04035

04036 **Erickson, J. Mark.** A floating coring platform for use on sheltered lakes: Compass, v. 47, no. 3, p. 169-173, illus., 1970.

In order to recover a complete record of sedimentation in a lake basin it is best to obtain continuous cores from the deepest part, which may necessitate coring in open water. A floating coring platform was designed for use on Glovers Pond in northwestern New Jersey. It was made of wood and given additional buoyancy by use of two large blocks of styrofoam. Using this platform and a modified Colinvaux corer, two continuous cores, which bottomed more than 17 m below the lake surface and 7.5 m below the floor, were taken with no difficulty. The barrel reached stiff lake clay and eventually till below the lacustrine sediments. — ESL

03915 **Estes, Richard; Frazzetta, T. H.; Williams, Ernest E.** Studies on the fossil snake *Dinilysia patagonica* Woodward — Pt. 1, Cranial morphology: Harvard Univ. Mus. Comp. Zoology Bull., v. 140, no. 2, p. 25-73, illus., 1970.

This essentially complete Cretaceous reptile from Argentina was described in 1901; the present review indicates that Woodward mistook it as a typical member of the Ophidia, but was partially correct in relating it to the modern burrowing *Anilius*. Redescribed in detail, the distinctly snakelike skull has primitive lizardlike characters more numerous than those in modern snakes and not related to any particular group of lizards; most are probably generalized lepidosaurean features. Some aspects of the occiput and the palate resemble those of Recent platynotan *Lanthanotus*; nonplatynotan are deep choanal impressions on palatines. *Dinilysia* is a mosaic, clearly a snake in spite of lizardlike features; it appears to be a very early and eccentric divergent offshoot at base of the superfamily Booidea, away from the main line of snake ancestry. — GDC

Evans, D. S. *See* Meyer, W. T. 04323

03957 **Evans, James O.** The soil as a resource renovator: Environmental Sci. and Technology, v. 4, no. 9, p. 732-735, illus., 1970.

The renewal value of animal wastes, including human excreta, has been recognized for many centuries. In the multifunctional soil, as a cleansing and renovating agent, microorganisms responsible for biological purification have their common origin. So-called waste waters are recycled gradually by nature or more rapidly by man. Land disposal of treated sewage is an outstanding example of reuse of materials that should be considered assets rather than liabilities. Esthetic objections and fears of poison are discussed, as well as competing costs of treatment and transportation. Cultivated soils need not be favored sites of application; forest soils have superior absorbing capacities for assimilation and use of fluid wastes, and the high evapotranspiration rates of trees can very effectively remove large excesses of miosture. — GDC

04207 **Evernden, Jack F.; Evernden, Roberta K. Smith.** The Cenozoic time scale, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 71-90, illus., table, 1970.

The Cenozoic time-scale, down to Stage-Age level for North American mammal-bearing strata and for some marine sequences, and to major Pleistocene cultural levels, has been established by K-Ar dating. Materials used for dating Cenozoic rocks must have a fixed K content, and no loss of radiogenic Ar. Authigenic or primary minerals must be used because it is the source rock not the sedimentary deposit that is dated; most major minerals of volcanic or intrusive rocks of the Cenozoic Era are suitable. Materials to be avoided include intrusive feldspars, volcanic feldspars with intermediate K values, glauconite, illite, whole-rock basalt samples, and glass shards. Care should be taken that only unaltered mineral grains are used. With properly prepared samples and analytical care, Ar and K measurements of sample splits are reproducible to a fraction of 1 percent. — *from* Authors' abstract

Evernden, Roberta K. Smith. *See* Evernden, Jack F. 04207

Ewing, J. *See* Houtz, R. 03968

04271 **Ewing, J.; Windisch, C.; Ewing, M.** Correlation of horizon A with JOIDES borehole results: Jour. Geophys. Research, v. 75, no. 29, p. 5645-5653, illus., 1970.

Horizon A, a prominent and extensive reflective zone in the North Atlantic deep-sea sediments, has been sampled by the JOIDES drilling project. Cores show that the top of the horizon is generally a synchronous zone of Early-Middle Eocene age, and that its reflective nature is the result of the layers of chert. The horizon appears to be synchronous with a similar horizon in the South Atlantic and with horizon A″ of the Caribbean, but synchronism with horizon A′ in the Pacific is not definitely established. The great extent of horizons A and A″ suggests that Eocene chert layers may be important stratigraphic markers in marine deposits in continental areas. — Authors' abstract

Ewing, M. *See* Ewing, J. 04271

04230 **Faddick, Robert R.** Effect of unit weight and slope on erosion — Discussion [of paper 6984 by R. L. Foster and G. L. Martin, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Irrigation and Drainage Div., no. IR3, p. 372-373, 1970.

Paper 6984 (ibid., v. 95, no. IR4, p. 551-561, 1969) was cited in Abs. North American Geology, May 1970.

Fagan, James M. *See* Maher, Stuart W. 03981

Faile, S. P. *See* Roy, D. M. 03834

03922 **Fairbairn, Harold W.; Hurley, Patrick M.** Northern Appalachian geochronology as a model for interpreting ages in older orogens, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 83-90, illus., 1970.

An interpretation of a plot of isochron data from the northern Appalachians suggests that: (1) The observed age band actually consists of a complex of discrete intrusive or metasomatic events that covers the time range within the bounding isochrons; (2) the initial Sr-87/Sr-86 ratios given by separate isochrons on granitoid rocks are similar enough that ages calculated on individual samples using the observed "common" initial Sr-87/Sr-86 ratio are likely to be true; (3) acid extrusive volcanic rocks frequently give ages less than the time of extrusion and have higher initial Sr-87/Sr-86 ratios, and thus should be avoided in sampling; (4) regional thermal rejuvenation of K-Ar ages in the northern Appalachians has not affected the whole-rock Rb-Sr dating so that a similar happening will not invalidate the above general interpretations in the case of an ancient orogenic region. — GV

Farnham, Paul R. *See* Mooney, Harold M. 04007

04363 **Farnham, R. S.; Grubich, Donald N.** Peat resources of Minnesota — Potentiality report, Fens bog area, St. Louis County, Minnesota [Inventory Rept. 4]: St. Paul, Minn., Minnesota Office Iron Range Resources and Rehabilitation, 40 p., illus., tables, 1970.

The Fens bog area, south of Mesabi Iron Range, extends over 40 sq mi in the glacial Lake St. Louis basin. The underlying clay, silt, and fine sand were deposited in the proglacial lakes during retreat of the Superior lobe and St. Louis sublobe glacial advances. There are also occasional discontinuous beach ridges, silt and clay deposits and deltaic sands, some loamy glacial till, and red clay till. Moraines south of the bog blocked outlets for the lake which occupied the region for 2000-4000 years following glacier retreat, then slowly decreased in size with peat formation. Fairly rapid accumulation of peat in the last 3000 years caused its widespread expansion and raised areas of sphagnum moss. Water-table levels parallel the peat land surface as well as the old glacial lake plain. Physical and chemical properties make the peat well suited to commercial harvesting as well as crop land. — GDC

04267 **Feder, G. L.** A semiquantitative method for determining the source of springflow in the Missouri Ozarks, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C214-C217, illus., 1970.

Springflow-recession curves in conjunction with data on carbonate saturation can be used to make semiquantitative determinations of source of springflow in terranes of carbonate rock of the Missouri Ozarks. The recession curve having the maximum slope represents rapid local drainage through nearby sinkholes, losing streams, cave networks, flow from the regional artesian aquifer, and periods of maximum regional flow from the aquifer. As local drainage is depleted, the curve slowly approaches minimum slope and primarily represents flow from the aquifer. During periods when the curve approaches maximum slope, saturation of the water with respect to dolomite is low, reflecting short residence time of local drainage. As minimum slope of the curve is approached, saturation with respect to dolomite increases and reflects greater distance traveled and longer residence time of the regional artesian water. — Author's abstract

04121 **Feduccia, J. Alan.** A new shorebird from the Upper Pliocene: Graduate Research Center Jour., v. 38, nos. 3-4, p. 58-60, illus., 1970.

The humerous of a scolopacine shorebird which closely resembles the Recent *Tringa solitaria* was recovered from the Saw Rock Canyon local fauna of the Upper Pliocene of Seward County, Kansas. Many of the mammals in the Saw Rock Canyon local fauna, taken from a lower section of the Rexroad formation than the sites of the Fox Canyon and Rexroad local faunas, are considered to be ancestral to them; a late Hemphillian age is favored. The fossil holotype *Tringa antiqua*, n.sp., was compared with those of 77 extant species of a number of avian genera; shorter than that of the *T. solitaria*, the humerous is larger at distal end, and has a less robust shaft. This is the first record of *Tringa* prior to the Pleistocene, although many shorebird genera extend far back into the Tertiary. — GDC

Fehrenbacher, J. B. *See* Bushue, L. J. 03937

Feist, Oliver J., Jr. *See* Fishman, Marvin J. 04429

03883 **Ferguson, Laing.** Sedimentary evidence for the allochthonous origin of *Stigmaria*, Carboniferous, Nova Scotia — Discussion [of paper by N. A. Rupke, 1969]: Geol. Soc. America Bull., v. 81, no. 8, p. 2531-2534, 1970.

For original reference, see ibid., v. 80, no. 10, p. 2109-2114, 1969; Abs. North American Geology, March 1970.

04188 **Ferrigno, Kenneth F.** Holothurian sclerites from the Dundee Limestone in southwestern Ontario: Compass, v. 47, no. 2, p. 81-83, illus., table, 1970.

Recovery and identification of specimens of the holothurian sclerites *Protocaudina kansasensis* (Hanna) from the Dundee Limestone of Middle Devonian age extends the range of the genus to older Devonian rocks. The species *P. kansasensis* has not been reported previously from rocks older than Pennsylvanian. — Author's abstract

Feugere, G. *See* Lucon, C. 03790

04336 **Filson, John.** Long period SH_n: Seismol. Soc. America Bull., v. 60, no. 4, p. 1297-1307, illus., 1970.

The theory of Cagniard applied to the model of a point source of torque in a layer overlying and welded to a half-space of higher velocity has been used to approximate satisfactorily observed long-period SH_n wave forms recorded from regional shallow earthquakes in California. The model assumed is consistent with a crustal thickness of about 20 km in extreme western central California. An effective source time duration of about 10 secs appears reasonable for the earthquakes considered in the magnitude range of 5 to 5.5. — Author's abstract

04304 **Fishman, Marvin J.; Pascoe, Ralph F.** The use of automated titrimetry for analyses of natural water, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C222-C225, illus., tables, 1970.

Automated titrimetric analysis has been applied to the determination of alkalinity, chloride, and sulfate in fresh water. Replicate analyses and comparison of results with those obtained by similar manual titration methods show that automated titrimetric methods are accurate and reproducible, and provide a rapid means for the determination of these substances in water. — Authors' abstract

04429 **Fishman, Marvin J.; Feist, Oliver J., Jr.** Automated potentiometric determination of chloride in water, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C226-C228, illus., tables, 1970.

Chloride is determined with standard silver nitrate solution by automated potentiometric titration using chloride ion-selective and reference electrodes. Replicate analyses and comparison of results with those obtained by other automated methods show that the automated potentiometric method is as accurate and reproducible as other methods, and provides a rapid means for the determination of chloride in water. — Author's abstract

Flinn, Edward A. *See* Harkrider, David G. 03978

Flint, R. F. *See* Hindall, S. M. 03982

03923 **Folinsbee, Robert E.; Baadsgaard, Halfdan; Cumming, George L.** Geochronology of the Cretaceous-Tertiary boundary of the western plains of North America, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 91, 1970.

A complete marine and continental Late Cretaceous sequence in Alberta and Montana contains datable bentonite beds (sanidine- and biotite-bearing volcanic ash) and has presented unique opportunities to obtain a sequence of dates through latest Cretaceous into Paleocene time and to define radiometrically the Cretaceous-Tertiary boundary. The formations involved are discussed. — GV

04383 **Font, Robert G.; Williamson, Edward F.** Geologic factors affecting construction in Waco, *in* Urban geology of greater Waco — Pt. 4, Engineering: Baylor Geol. Studies Bull. 12, 34 p., illus., 1970.

The purpose of this study is to make a systematic research of the geology of the city of Waco and adjacent areas as it applies to engineering problems which may be encountered in the future development of the city. The city is underlain by eastward-dipping rocks, which are broken up near Waco by the Balcones fault which trends N-S through the city. Problems in drainage, septic sewage disposal, excavation, foundation design, etc., are the result. The Brazos and Bosque river terraces produce seasonal amounts of polluted ground water and provide reservoirs for disposal of waste water. The properties of the various formations which lie below the city area are reviewed in connection with their engineering geology properties, problems, and potentials. — HRC

Ford, D. C. *See* Drake, J. J. 04055

04206 **Forman, John A.** Age of the Catalina Island pluton, California, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 37-45, table, 1970.

The Catalina Island quartz diorite pluton yields a K-Ar date of 19 m.y. (middle or early Miocene) and amphibolite of the Catalina Schist 106 m.y. (Late Cretaceous). The first date gives an upper limit to the age of the overlying middle Miocene San Onofre (?) Breccia. Although the second date is somewhat younger than previously reported ages for similar Franciscan eclogites and amphibolites, it lends support to the correlation of the Catalina Schist with the Franciscan rocks in northern California. The Miocene pluton is of considerable interest because it is the only known "granitic" intrusion into the Franciscan rocks and because of its similarity to other West Coast plutons which intrude continental crust. — Author's abstract

04200 **Foscolos, A. E.; Barefoot, R. R.** A rapid determination of total sulphur in rocks and minerals: Canada Geol. Survey Paper 70-11, p. 9-14, illus., tables, 1970.

Procedure and apparatus for determining sulphur in rocks and minerals are described. Results obtained for United States Geological Survey standards, standard chemicals, and other sulphur standards are accurate and reproducible. The method is extremely rapid. — Authors' abstract

04384 **Foscolos, A. E.; Barefoot, R. R.** A rapid determination of total organic and inorganic carbon in shales and carbonates: Canada Geol. Survey Paper 70-11, p. 1-8, illus., tables, 1970.

Procedure and apparatus for determining inorganic and organic carbon in shales and carbonates are described. Results obtained by the proposed method [direct measurement of total C and organic C, inorganic C being the difference] are comparable to those obtained by (1) the United States Geological Survey, (2) other analysts, and (3) X-ray diffraction; they are accurate and reproducible. The method is very rapid. — Authors' abstract

04074 **Fox, Richard C.** Eutherian mammal from the early Campanian (Late Cretaceous) of Alberta, Canada: Nature, v. 227, no. 5258, p. 630-631, illus., 1970.

This letter describes the first right upper molar of a small eutherian from the upper Milk River Formation and provides the oldest record of eutherian from the North American Late Cretaceous. The molar resembles those of early representatives in several lineages of Late Cretaceous and Paleocene eutherians. — DBV

04097 **Frankel, L.; Crowl, G. H.** Permo-Carboniferous stratigraphy and structure of central Prince Edward Island (11 L, and part of 21 I): Canada Geol. Survey Paper 69-17, 26 p., illus., table, 1970.

The Permo-Carboniferous and perhaps younger rocks consist mainly of sandstone, with lesser amounts of conglomerate, mudstone breccia and mudstone and are assignable to subunits A2 and A3, and unit C of the stratigraphic sequence established in southeastern Prince Edward Island. Subunit A1 and unit B have not been seen in the map-area. Unit C and subunit A3 are unconformable. The major structure is a northeastward plunging syncline whose axis seemingly parallels those of Gallows Point anticline and Kilmuir syncline lying 16 and 24 miles respectively to the southeast. Faults bound a complex graben or tilt-block structure trending northwest-southeast across the central part of the island. This faulting occurred after the deposition of unit C. — Authors' abstract

04423 **Fraunfelter, George H.** Silicified corals from the Lingle and St. Laurent Limestones (Middle Devonian) of southern Illinois and southeastern Missouri: Southern Illinois Studies, no. 3, 68 p., illus., table, 1970.

Previous stratigraphic and paleontologic work, relating to corals, on the Lingle and St. Laurent Limestones is reviewed. The fossil silicified coral fauna, including nine new species — *Amplexiphyllum pauciseptum*, *Aulacophyllum multiseptum*, *Craterophyllum brevicyathum*, *Heterophrentis delicalycula*, *Odontophyllum cornutiformis*, *Syringopora neoperelegans*, *Tabulophyllum variformis*, *Trachypora eoprobocidialis* and *Trachypora intercedens* — is described and figured. — Author's abstract

Frazzetta, T. H. *See* Estes, Richard. 03915

04446 **Friedlaender, C. G. I.** Brownian movement in liquid inclusions in quartz, some quantitative observations [with French abs.]: Canadian Mineralogist, v. 10, pt. 2, p. 272-274, table, 1970.

The viscosity of the liquid in an inclusion in quartz from Dunbrack Prospect, Musquodoboit River, Halifax County, Nova Scotia, has been tentatively calculated based on the evaluation of a movie film of Brownian Movement of a gas bubble. — Author's abstract

03780 **Friedman, Gerald M.; Sanders, John E.** Coincidence of high sea level with cold climate and low sea level with warm climate — Evidence from carbonate rocks: Geol. Soc. America Bull., v. 81, no. 8, p. 2457-2458, 1970.

Two examples are described in which extremes of climate and sea level do not appear to coincide. Evidence based on carbonates suggests a warm peak 10,000 to 12,000 yr ago when sea level was low. Faunal evidence suggests cold climate about 4,300 yr ago when the sea was at its present high level. — *from* Authors' abstract

Friedman, Irving. *See* Wershaw, R. L. 04086

04066 **Frimpter, Michael H.** Ground-water basic data, Orange and Ulster Counties, New York: New York Water Resources Comm. Bull. 65, 93 p., illus., tables, 1970.

This report makes available basic ground-water data to supplement an interpretive report to be published as a U.S. Geol. Survey Water-Supply Paper. Tabulated data are: records of selected wells and springs, lithologic logs of wells and test borings, and chemical analyses of well water. Maps in pocket show locations of selected wells, springs, and test borings in the two counties. — MCM

Fritz, W. H. *See* Norford, B. S. 04100

03950 **Froelich, Albert J.** Field trip No. 1, Geologic features of southeastern Kentucky — Pt. 1, Landslide geology along south slope of Pine Mountain, Pineville to Harlan, *in* Guidebook for field trips — Geol. Soc. America, Southeastern Sec., 18th Ann. Mtg., Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, p. 5-11, illus., 1970.

The valley of the Cumberland River here is carved in rocks of Pennsylvanian age that form the south slope of Pine Mountain on the north limb of the Middlesboro syncline. Crossbedded sandstones in upper part of the Lee Formation are overlain by

a less resistant sequence of interbedded shales, siltstones, sandstones, coal beds, and underclays in the lower part of the Breathitt Group. Regional dip is south-southeast except where interrupted by local cross structures. Landsliding conditions, shown at six roadcuts on the Pineville-Harlan route, include water seeps in fractured sandstone and in underlying coal bed and underclay, weak shales, joints, rotational elements, and a shale-siltstone sequence contorted possibly by a gravity-induced tear fault. — GDC

04144 **Frondel, Clifford.** New minerals from New England: Mineralog. Rec., v. 1, no. 2, p. 46-53, illus., table, 1970.

The names of the 99 new or supposedly new mineral species that have been discovered in New England up to the present time are listed in the table, including the author and year of description (full references in a footnote) together with the original locality and the present status of the name. The names of 32 minerals in the list that are today accepted as valid mineral species are printed in heavy type. The remaining mineral names have become discredited for various reasons, including proven identity with some earlier known mineral, inadequate or erroneous descriptions, or the impure or altered nature of the substance described. The history of mineral identifications in New England is briefly reviewed. — GDC

Fyfe, William S. *See* Verhoogen, John. 03811

Gaines, A. F. *See* Buravas, S. 04368

04212 **Gaines, Richard V.** The Moctezuma tellurium deposit: Mineralog. Rec., v. 1, no. 2, p. 40-43, illus., table, 1970.

Moctezuma mine, in west central Sonora, Mexico, from 1935 to 1945 shipped 2,900 tons of hand-sorted gold ore giving a net smelter return of about 62 dollars per ton; in 1961 its high content of tellurium was investigated, but insufficient ore was found to justify treatment. The San Miguel prospect 10 km northwest, explored by a 100-ft tunnel and shallow shaft, is a tough barite-quartz intergrowth containing pyrite, tellurium, tetrahedrite, and possibly rickardite as primary ore minerals, the joints coated with oxidized minerals. Moctezuma mine is in a sub-parallel group of five quartz veins in fractures of steeply folded tuffaceous sediments (late Cretaceous or early Tertiary), with wall rock hydrothermally altered and veins brecciated. Further investigation has revealed other minerals. A total of 39 found at the mine are listed in order of abundance, of which 19 are tellurium minerals with 12 new; 16 are briefly described. — GDC

03870 **Galton, Peter M.** Ornithischian dinosaurs and the origin of birds: Evolution, v. 24, no. 2, p. 448-462, illus., 1970.

The postpubic rod of ornithischians is demonstrated to be homologous with the pubis of birds; the ornithischian prepubic process, like the analogous pectineal process of birds, was developed not for abdominal support but as an attachment for leg muscles, and was probably formed after the main part of the pubis came to lie parallel and close to the ischium, resulting in a posterior shift of the center of gravity that was advantageous to a bipedal animal. Skeletal differences preclude derivation of birds from any known ornithischian; however, their common ancestor may have been a cursorial biped of the Middle Triassic with a long anterior process to the ilium and a backward directed pubis. Later ornithischian specializations resulted from adaptations to a herbivorous diet; the cursorial preproavians gave rise to the arboreal proavians and thence to *Archaeopteryx* and other birds. — VMJ

Gamble, E. E. *See* Daniels, R. B. 03935

Gamble, E. E. *See* Daniels, R. B. 03990

04361 **Gamer, Robert L.** Geology of the Klamath Mountains campout: Geol. Soc. Oregon Country News Letter, v. 36, no. 9, p. 66-72, illus., 1970.

The Klamaths are made up of several ranges, extending from Roseburg, Oreg., to Redding, Calif., and are older than the Coast Ranges and Cascades. Geologically the Klamaths are similar to the Sierra Nevada and Blue Mts., and their history spans an interval from early Paleozoic to the present. Types of rocks present in the various formations and intrusions are described. Discussion of the history of the area covers the Abrams Sea, Ordovician; Applegate Mts., Triassic; the Nevadan revolution, Jurassic; Jurassic thrust faulting; Laramide revolution; Tertiary mineralization and peneplanation; and gold accumulation. — ESL

Gasch, Jerrie W. *See* Geological Society of Sacramento. 03951

Gasparini, E. L. *See* Naldrett, A. J. 04413

Gassaway, J. D. *See* Andersen, N. R. 03996

04297 **Gaucher, Edwin; Saint-Amant, Marcel.** Evaluation of E.M. anomalies at SOQUEM: Canadian Mining and Metall. Bull., v. 63, no. 697, p. 567-572, illus., 1970.

Among the electromagnetic surveys performed by SOQUEM in the last three years, a certain number of the more instructive cases have been chosen to illustrate the theory of electromagnetism by field examples of: (a) the depth penetration of the TURAM as compared to the SLINGRAM (Ronka) method; (b) the limitations of the TURAM as compared to the SLINGRAM method when a conductor dips the wrong way, or when it is small in size; (c) the expression of a shallow-dipping conductor in a SLINGRAM survey; (d) the effect on the SLINGRAM survey on deep ditches or reef structures; (e) a comparison between the CRONE and the SLINGRAM method in the Abitibi clay belt, by means of field and model studies, indicating a usually better signal-to-noise ratio for the SLINGRAM method. From the above and from other experiments, different electromagnetic methods are now being used by SOQUEM, depending on field conditions. — Authors' abstract

03924 **Gees, Rudolf A.** K-Ar ages of two basalts from Bermuda, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 93, 1970.

The age of two small basalt samples was determined by the K-Ar method (whole rock). One sample, originating from a depth of 715 feet in a well near the Gibbs' Hill lighthouse, yielded an age of 34.4 (± 3) m.y. The second sample taken from a well at the causeway across Ferry Reach (depth 140-145 feet), yielded an age of 52.4 (± 2.5) m.y. Both ages should be considered somewhat tentative, because rapidly chilled submarine basalts may not be completely outgassed of radiogenic Ar and He at the time of the eruption. — *from* Author's summary

Gehlen, K. v. *See* Schiller, W.-R. 04321

03861 **Geol. Soc. America SE Sec.** Guidebook for field trips, 18th annual meeting, Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, 70 p., illus., tables, 1970.

This guidebook was prepared for four field trips, south and southeast of Lexington. For the first, in two parts, A. J. Froelich discusses landslide features on the north slope of Pine Mountain, and M. C. Noger and L. R. Ponsetto, middle and upper Paleozoic rocks cut by the Cumberland River there, and the stratigraphic section from London to Lexington. For the second trip, E. R. Cressman describes lithology of the Lexington Limestone (Ordovician) of central Kentucky, and O. L. Karklins its bryozoan zonation. For the third, G. W. Weir considers lithofacies of the Borden Formation (Mississippian) in several exposed southeast-central sections. For the fourth (two parts), examining the Paleozoic section on the east flank of the Cincinnati Arch along Interstate 64, Weir takes it east from Lexington to Licking River valley, and J. C. Philley points out features of the Mississippian from there to Olive Hill. — GDC

03951 **Geological Society of Sacramento; Gasch, Jerrie W.; Matthews, Robert A.** (editors). Geologic guide to the Death Valley area, California, annual field trip guidebook, 1970: Sacramento, Calif., Geol. Soc. Sacramento, 86 p., illus., geol. map, 1970.

The guidebook contains five papers, four of which are cited separately. Appendix 1 describes selected stops on the trip; Appendix 2 is a reproduction of the National Park Service Pamphlet on Death Valley Natl. Monument; and Appendix 3 is a reprint of California Division of Mines and Geology Mineral Information Service, v. 11, no. 10, 1958, giving the geology of the area. A reproduction of a geologic map of the area, compiled in 1954, accompanies the guidebook. — ESL

Gerard, R. E. *See* Lucon, C. 03790

04373 **Geyer, Richard G.** Effect of subsurface geologic structure in electromagnetic induction prospecting: Mines Mag., v. 60, no. 6, p. 7-8, illus., 1970.

A study of the effect of an irregular subsurface horizon on the electromagnetic field is presented. The Earth is modeled by two conductive layers which are joined at a nonplanar interface. In order to evaluate the electric and magnetic fields, a set of integral equations is formulated for a rather general shape of the interface. A solution is then found by using a perturbation technique, and the particular cases of the effects of an anticlinal ridge and a synclinal trough on the electromagnetic field and measured apparent resistivity are considered. Numerical evaluation of the electromagnetic field at the Earth's surface is protrayed for various geometries of the sub-surface geologic structure, various resistivity contrasts between the two layers, and various depths to the interface between the first and second layer. An example of the normalized horizontal electric field anomaly over a buried triangular-shaped ridge is illustrated. — GV

04069 **Gibowicz, Slawomir J.** P-wave travel time residuals from the Alaskan aftershocks of 1964: Physics Earth and Planetary Interiors, v. 2, no. 4, p. 239-258, illus., tables, 1970.

Some 9,889 observations of traveltime residuals of P-waves from 90 aftershocks of the Alaskan 1964 earthquake have been analyzed by a least-squares technique. Deviations from the J-B tables have been separated from the station effect and anomalies of azimuth and epicentral distance revealed by station residuals. Azimuth-distance dependent anomalies (regional residuals) were calculated for 7° azimuth cells in the range 269° to 140°, and for 2° distance cells in the range 3° to 93°. Station residuals are considered to three approximations: after separation from J-B traveltime corrections, and after removing azimuthal and distance effects. Station residuals to the third approximation are in general smaller than those to the first approximation; they do not show a marked regional trend, and their frequency distribution is fairly normal. No evidence of correlation with station height was found. — *from* Author's abstract

03874 **Gibson, Shirley.** (compiler). Faraday Township, Hastings County (data series): Ontario Dept. Mines and Northern Affairs Prelim. Map P. 608, scale 1 in. to 1/2 mi., text, 1970.

Faraday Township is underlain by Grenville metasediments intruded and replaced by a series of mafic and felsic plutonic rocks. A long erosion interval has reduced the area to a peneplain; thin Pleistocene glacial deposits cover much of the bedrock. Uranium, mica, and marble have been mined. — MCM

Giletti, Bruno J. *See* Hofmann, Albrecht. 04011

04104 **Gill, H. L.** Soil-pile interaction under lateral loading, Paper 17 *in* In situ investigations in soils and rocks — British Geotechnical Soc., Conf., London, 1969, Proc.: London, British Geotechnical Soc., p. 221-227, illus., table, 1970.

In field tests to study lateral load-displacement characteristics of natural soil deposits and to associate them with behavior of laterally loaded piles, bay mud with dessicated crust, submerged bay mud, and hydraulic fill of granular material were considered. Tests were performed with a segmental pile developed for horizontal load tests at various depths in undisturbed soil samples, and lateral load tests on full-scale flexible piles. Published information, measured properties, theoretical information, and results of segmental pile tests were compared to establish representative lateral load-

displacement relations for soil at any depth. Provisions were made to account for nonlinearity of soil response and variation of soil properties with depth. Theoretical predictions of response of laterally loaded piles compare favorably with test data. — *from* Author's abstract

Gillham, C. J. *See* King, H. W. 04135

Gillott, J. E. *See* Penner, E. 03945

04091 **Given, P. H.; Spackman, W.; Cohen, A.; Imbalzano, J.; Casida, L. E.; Hiscott, T.** Botanical, chemical and microbiological studies of peat accumulation processes in the Everglades of Florida [abs.], *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 313-314, 1970.

Given, P. H. *See* Vastola, F. J. 04093

Gizienski, Stanley F. *See* Noorany, Iraj. 04222

Godden, C. A. *See* Pelletier, B. R. 04380

04269 **Goebel, Lorna M.** Analysis of rhenium in molybdenites: New Mexico Bur. Mines and Mineral Resources Circ. 108, 17 p., illus., tables, 1970.

Current procedures for the analysis of rhenium are based on separation methods that fail to isolate rhenium from interfering elements. Of several analytical methods studied, calcining with calcium oxide, leaching with a hot aqueous oxidizing solution, and spectrophotometrically determining the concentration of rhenium with a α-furildioxime produces the most reliable results. Using this procedure, a sample of Arizona molybdenite concentrate was shown to contain 320 ppm rhenium with a 95-percent confidence interval of 10 ppm and a standard deviation of 4.97 percent; standard deviations as low as 0.79 percent were obtained on single runs of four or more replicates. Published standard deviations for conventional analyses of the same material average about 20 percent. Recovery of 90 to 100 percent of added standards was obtained up to a total rhenium content of 500 ppm for a 1-g sample. — Author's abstract

Goldberg, Edward D. *See* Klein, David H. 03954

03867 **Goldthwait, Richard P.** Suggestions for the collection of glaciology data: Ice, no. 33, p. 14-19, 1970.

Suggested are sorts of data which have proven useful and necessary in studies of glaciology, a broad interdisciplinary field involved in geophysics, geochemistry, climatology, geology, hydrology, pedology, and oceanography. These data are sought by and stored in the World Data Centers for Glaciology, in New York, U.S.A.; Moscow, U.S.S.R.; and Cambridge, England. Subjects collected are listed by experts in each of 16 fields: snow, glacier meteorology, glacier maps, variations in snow-ice limits, avalanches, physics-chemistry, glacier tectonics and geophysical profiling, mass budgets, hydrology, lake-river ice, sea ice, permafrost, periglaciology, polar soils, radiometric measurements, and organizations. — GDC

03872 **Golubic, Stjepko; Brent, Gayle; LeCampion, Thérèse.** Scanning electron microscopy of endolithic algae and fungi using a multipurpose casting-embedding technique: Lethaia, v. 3, no. 2, p. 203-209, illus., 1970.

An embedding-casting method preserves endolithic algal and fungal structures and makes them optically accessible by removal of carbonate matrix. With variations in preliminary fixation and dehydration procedures, the method is applicable to fresh, dry, and fossil materials (except when borings are already filled with sediment), as diagrammed on accompanying flow chart. Slow penetration by a mixture of Epon-812 and acetone fills the fine borings and embeds the organisms in place; the calcareous matrix is then dissolved in HCl, leaving the remaining Epon, with embedded or-

ganisms, as a cast reflecting the surface details of the former tunnels. The casts are studied by scanning electron-microscope and incident light microscope. The casts are re-embedded in Epon and thin-sectioned for study by regular electron and transmitted light microscopy. — VMJ

04171 **Good, Charles W.** The apical organization of *Calamites* [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 756-757, 1970.

04172 **Good, Charles W.** Ontogenetic studies of the cone *Calamostachys binneyana* [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 757, 1970.

04047 **Goody, Peter C.** Comments on enchodontid paper by [C. L.] McNulty [Jr.] and [G.] Kienzlen [1970]: Texas Jour. Sci., v. 21, no. 4, p. 455-457, 1970.

For the original paper, "An enchodontid mandible from the Eagle Ford Shale (Turonian), Dallas County, Texas," *see* ibid., p. 447-453, 1970. — ESL

04445 **Gough, D. L.; Porath, H.** Long lived thermal structure under the southern Rocky Mountains: Nature, v. 226, no. 5248, p. 837-839, illus., 1970.

Two induction anomalies associated with transient electric currents in N-S conductors beneath the Southern Rockies in Colorado and beneath the Wasatch fault belt in Utah are closely related to the pattern of heat flow through the crust of the Earth. Coincidence of geomagnetic deep sounding anomalies and heat-flow anomalies means not only that the conductive structures related to the former are almost certainly thermal, but also that these parts of the upper mantle have been hot for a long time. The coincidence of heat flow and induction anomalies greatly increases the probability that associated upper mantle structures are old enough to be connected with the origins of overlying mountains and structural provinces. Calculations suggest that the heat-flow anomaly is more than 200 m.y. old, if it arises from the postulated structure. — DBV

04313 **Graf, Joseph L., Jr.; Skinner, Brian J.** Strength and deformation of pyrite and pyrrhotite: Econ. Geology, v. 65, no. 2, p. 206-215, illus., 1970.

Deformation tests show that pyrite fails by brittle fracture after a small amount of elastic (recoverable) compression, over a wide range of temperature, confining pressure, and strain rate. No evidence for plastic behavior was found, and it is suggested that pyrite behaves as a brittle substance under all conditions of deformation in the Earth's crust. Pyrrhotite, on the other hand, deforms inelastically under most conditions to be expected in the Earth's crust, and present evidence suggests that twinning, by presently undetermined laws, and translation gliding on (0001) are the important mechanisms. The pyrrhotite used had a composition of 46.7 atomic percent Fe, corresponding to a temperature of 450°C on the high temperature pyrrhotite solvus (Arnold, 1962). In deformation tests below 450°C it was qualitatively observed that coarse grained pyrite nucleated and grew much more readily in the presence of shear stresses than in their absence. — Authors' abstract

03882 **Green, John C.** Snowflake texture not diagnostic of devitrified ash-flow tuffs — Discussion [of "Development of snowflake texture in a welded tuff. . ." and "Recognition and time distribution of. . . welded tuff" by J. E. Anderson, Jr., 1969 and 1970]: Geol. Soc. America Bull., v. 81, no. 8, p. 2527-2528, illus., 1970.

For original references, see ibid., v. 80, no. 10, p. 2075-2080, 1969, and v. 81, no. 1, p. 287-292, 1970 (Abs. North American Geology, March and July 1970).

03928 **Green, Morton.** Functions of a university museum: Jour. Geol. Education, v. 18, no. 4, p. 161-162, 1970.

Three basic functions of a science museum are: preservation and storage of scientific materials; education; and initiation of new research and vitalization of continuing research on materials in the museum. This paper is particularly concerned with the second. The museum at South Dakota School of Mines and Technology is a museum

of geology, housing minerals, rocks, and fossils, and its staff are also teachers of geology. Materials are available to research scientists, but labels are being rewritten so as to be more informative to laymen. The identification of specimens is part of the educational function. Letters of inquiry, reasonable and unreasonable, are discussed, and it is requested that teachers see that students use all available local source material before writing universities. — ESL

Greenblatt, M. *See* Banks, E. 04367

04264 **Gregg, Dean O.** Rock movement triggered by a water-level change in the Brunswick area, Georgia, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C198-C201, illus., 1970.

Anomalous water-level fluctuations attributed to rock movement were recorded simultaneously in three wells tapping the principal artesian aquifer in Glynn County, Ga. During the time of the fluctuations, water levels in the area were rising after an industrial shutdown for the 1964 Christmas holidays and a massive reduction in ground-water withdrawals. It is postulated that the rapidly changing pressures superimposed on older unresolved stress conditions may have triggered subsidence or movement along a suspected fault zone. — Author's abstract

03868 **Gregory, Gardiner E.** Mineral locations in Pennsylvania: Gems and Minerals, no. 397, p. 24-27, 49, illus., 1970.

There are many collecting sites for fossils in Pennsylvania, such as: the Indian Ladder Falls area, Deer Lake, St. Clair, Beltsville Dam, and road cuts on Rte. 80; each is described briefly and types of fossils listed. Working mines and quarries where there has been secondary mineralization are best for mineral collecting, and the first five listed and described are in this category: Faylor Lime and Stone, Kibblehouse, Showalter, and Cedar Hill quarries, and Bethlehem Steel Cornwall mine. Five other locations, inactive mines and quarries, are listed and described. — ESL

04054 **Gribbon, P. W. F.** Frontal recession of Sermikavsak, West Greenland [with German and French abs.]: Jour. Glaciology, v. 9, no. 56, p. 279-282, illus., 1970.

Results are reported from two surveys (1968 and 1969) of Sermikavsak Glacier, West Greenland, a typical valley type transitional between polar and temperate. Purpose of the surveys was to find evidence to support the reported new re-advance that may be under way in glacial lobes from the ice sheet in this area. Although average retreat rate of active ice is being maintained at $43 \pm$ m per yr^{-1} as compared to 42.5 ± 3 m per yr^{-1} for 1953-57, and 37 ± 2.5 m per yr^{-1} for 1957-58, the rate at which the ground area is being freed from the ice cover has decreased about 30 percent since the mid 1950's. The surveys also showed an increase in surface inclination of the front. If these results can be interpreted as a constant or decreasing mass loss rate, the glacier is behaving in a manner similar to nearby ice lobes on the ice sheet. — VSN

Grim, Paul J. *See* Epp, David. 04272

Gross, D. L. *See* Lineback, J. A. 03917

04320 **Grossling, Bernardo F.** Future mineral supply: Econ. Geology, v. 65, no. 3, p. 348-349, 1970.

The thesis that there is an impending worldwide depletion of minerals is challenged. Future supply appears to have been inadequately assessed. The mineral potential of various earth units needs to be investigated after proper allowance for technological discoveries, changed economic factors, and new ways of utilizing and recovering mineral products. — BFG

Grossman, Robert B. *See* Lynn, Warren C. 04019

Grubich, Donald N. *See* Farnham, R. S. 04363

04105 **Gryc, George.** Geologic framework of the North Slope petroleum province[abs.], *in* Alaska Sci. Conf., 20th, College, 1969, Proc.: Sci. Alaska 1969, p. 46-47, 1970.

04348 **Guidotti, Charles V.** The mineralogy and petrology of the transition from the lower to upper sillimanite zone in the Oquossoc area, Maine: Jour. Petrology, v. 11, no. 2, p. 277-336, illus., tables, 1970.

The transition from the lower to the upper sillimanite zone involves an isograd marking the disappearance of staurolite, interpreted as a function of prograde metamorphism under pressure-temperature conditions ranging from 575-630 C° and 3-5 kb. Modal and compositional data suggest a close approach to equilibrium and a model including buffering of H_2O (and therefore internal control) by the major dehydration reactions, with water pressure less than total pressure. — MS

Guilbert, John M. *See* Lowell, J. David. 04280

04254 **Gulbrandsen, R. A.; Cremer, Marcelyn.** Coprecipitation of carbonate and phosphate from sea water, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C125-C126, illus., table, 1970.

A precipitate composed dominantly of aragonite was obtained from sea water by increasing the pH of the solution. Analysis of the precipitate showed it to contain 0.064 percent P_2O_5, an amount that comes close to the average for analyzed limestones. The results of the experiment thus indicate that coprecipitation of carbonate and phosphate may be an important natural process. — Authors' abstract

Gumper, Frank J. *See* Sbar, Marc L. 04431

04355 **Gunther, P.; Hills, L. V.** Heterospory in *Ariadnaesporites* [with French abs.]: Pollen et Spores, v. 12, no. 1, p. 123-130, illus., table, 1970.

Abundant spores identical with *Ariadnaesporites longiprocessum* (Hills and Jensen, 1966) Hills, 1967 were recovered from the Late Cretaceous Brazeau Formation of west-central Alberta. Small spores were found in association with and commonly entwined with a larger spore of similar character; it is concluded that Hills and Jensen (1966) described the microspore and that this new find includes the megaspore. This association supports Tschudy's (1966) concept that the spores are remains of a heterosporous water fern. Future diagnosis of new species of *Ariadnaesporites* should include description of both micro- and megaspores. — *from* Authors' abstract

04285 **Haach, U.; Condie, K.; Kuo, Chin-Shin.** In situ Uranbestimmungen an Dünnschliffen und Gesamt-Urananalysen von ultramafischen Gesteinen mit Hilfe der Spaltspurenmethode [In situ uranium determination on thin sections and whole rock uranium analyses of ultramafic rocks with assistance of the fission-track method] [abs.]: Fortschr. Mineralogie, v. 48, no. 1, p. 8, 1970.

03983 **Haefeli, Charles.** Beispiel zur theoretischen Analyse von regionalen Grundwasserströmungen [An example of theoretical analysis of regional ground-water flow]: Ver. Schweizer. Petroleum-Geologen u. -Ingenieure Bull., v. 36, no. 90, p. 41-49, illus., 1970.

The author discusses previous research on ground-water flow, fluid and hydraulic potential, and describes the application of theoretical modeling to ground-water research, as well as the hydrogeological parameters which should be used. He outlines the limitations of such a program and gives as an example a model of a hydrogeological profile between Lake Simcoe and Lake Ontario in Canada. — EH

04410 **Hafer, George.** Fossil falls: Desert, v. 33, no. 6, p. 26-27, 33, illus., 1970.

During the Wisconsin stage of the glacial period, water was abundant in the northern Mojave Desert, Calif., with lakes and streams fed from melting glaciers in the Sierra Nevada. Owens Lake was 220 feet deep, and the overflow went south to fill China Lake, and from there to Searles Basin forming another lake, the overflow of which went east and north to fill Panamint Lake, 60 miles long and 900 feet deep. The gla-

cial waters finally came to rest in a trough to form Lake Manley, estimated to have been 90 miles long and 600 feet deep. The lake is gone, but the trough remains, and is called Death Valley. The connecting streams are not as well known as the extinct lakes. Fossil falls marks the site where the overflow from Owens Lake plunged over basaltic cliffs. The lava on cooling, had formed deep fissures which the overflow eroded. There are many potholes and the jagged basalt is smooth and polished. — ESL

Haffty, Joseph *See* Pinckney, Darrell M. 04281

Hafner, S. S. *See* Bush, W. R. 03905

04426 **Hafner, Stefan S.; Virgo, David.** Temperature-dependent cation distributions in lunar and terrestrial pyroxenes, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2183-2198, illus., tables, 1970.

The nuclear hyperfine splittings of Fe-57 in clinopyroxenes from two medium-grained lunar igneous rocks were investigated in connection with complementary studies of ortho- and clinopyroxenes from terrestrial rocks, to determine the oxidation state of the iron, cation distribution over the octahedrally coordinated sites, and corresponding equilibrium temperature. It was found that the cation distributions in Ca-rich pyroxenes are principally ordered. An equilibrium temperature below 675°C is indicated, comparable to that observed in orthopyroxenes from granulite facies and intrusive igneous rocks and unlike that of orthopyroxenes from Hawaiian volcanic rocks. A large apparent discrepancy between the equilibrium temperatures derived from the Fe^{2+}, Mg exchange reaction with the pyroxene phase and those derived from the oxygen isotope ratios between mineral phases in medium-grained lunar rocks may be due to the absence of an intergranular aqueous phase during the subsolidus history. — DBV

04033 **Hagmaier, J. Ladd.** Surface morphology of the Little Missouri Badlands, North Dakota: Compass, v. 47, no. 3, p. 141-146, illus., table, 1970.

The surface configuration of the Little Missouri Badlands may be quantitatively expressed by considering the surface geometry, areal relationships, proportional relief, and surface elements. A combination of known descriptive techniques and morphological laws relates these variables in a manner which allows drainage compositions to be predicted on the basis of correlation. Those variables which cannot be directly correlated serve as statistical interpretations of the surface forms. Detailed morphological descriptions of the Little Missouri Badland topography demonstrate that many of its topographic aspects are comparable to those in other badland areas; however, some are unique to the western North Dakota area and can be explained only in terms of local physical variations. — Author's abstract

03995 **Hale, Dan.** Archaeological and paleontological finds in the New Fern system (Jackson Co., Ala.): Natl. Speleol. Soc. NSS News, v. 28, no. 8, p. 105-106, 1970.

New Fern Cave was discovered in January 1969, and to date some 65,000 feet of passage have been explored. The remains of a campfire of reeds was discovered on the lowest level, 2,000 feet from either known entrance. Bones of two bears, a jaguar, and a wolf were found where the animals could not have climbed down, fallen in, or washed in. Radiocarbon dates are being run on the reeds. The bears, identified as *Arctodus simus*, are dated at about 10,000 years. The wolf, *Canis rufus*, recently became extinct in the southeast, and this specimen may be quite recent. Only a single canine tooth represents the jaguar, *Panthera onca augusta*. — ESL

Hall, H. T. *See* Rama Murthy, V. 04070

Hall, Henry T. *See* Yund, Richard A. 04349

Hall, J. R., Jr. *See* Richart, F. E. 03799

04161 **Hall, J. W.; Stidd, B. M.** Development of pollen in the genus *Vesicaspora* [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 758, 1970.

Hall, J. W. *See* Stidd, B. M. 04175

Hall, John W. *See* Stidd, Benton M. 04196

04004 **Halliday, W. R.; Anderson, C. H.** Glacier caves, a new field of speleology: Studies Speleology 1969, v. 2, pt. 2, p. 53-59, illus., 1970.

Recent exploration of the Paradise Glacier on Mount Rainier, Washington State, U.S.A., by members of the Cascade Grotto of the National Speleological Society has revealed an extensive cave system within the glacier. The authors describe the cave and its ice formations, discuss their formation, and appeal for information about glacier caves in other parts of the world. — Authors' summary

04228 **Hamel, James V.** Coefficient of friction of natural rock surfaces — Discussion [of paper 7121 by B. W. Paulding, Jr., 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1833-1835, table, 1970.

Paper 7121 (ibid., no. SM2, p. 385-394, 1970) was cited in Abs. North American Geology, January 1971.

Hamilton, R. M. *See* Healy, J. H. 03974

04305 **Hamilton, Thomas M.** Channel-scarp formation in western North Dakota, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C229-C232, illus., 1970.

A reconnaissance of the present gully system and valley surfaces of small drainage basins in western North Dakota indicates that channel-scarp formation may most often be the result of one of three general conditions. These conditions are: (1) cutoff of the downvalley toe of alluvial fill in tributaries by encroachment of a migrating main channel; (2) cutting on a local reach of steeper gradient as a result of (a) an extreme flood, (b) a shift toward greater precipitation causing channel degradation on the steeper reach, or (c) short time-separation between two storms; and (3) piping collapse. — Author's abstract

Hanshaw, Bruce B. *See* Back, William. 04129

Hanshaw, Penelope M. *See* D'Agostino, John P. 04250

04261 **Harbour, Robert L.** The Hondo Sandstone Member of the San Andres Limestone of south-central New Mexico, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C175-C182, illus., table, 1970.

The Glorieta Sandstone and the Hondo Sandstone Member of the San Andres Limestone are separate stratigraphic units in the Permian sequence in south-central New Mexico. The Glorieta Sandstone wedges out toward the south and southeast; whereas the Hondo, stratigraphically above the Glorieta, thickens toward the southeast. It is possible that the Glorieta and Hondo merge into one body of sandstone toward the north, but proof of this is lacking from the area of study. Although additional studies of grain size, mineralogy, and structural features are needed to determine the environment of deposition and means of transportation of these clastic sediments, the present study does resolve some basic correlation problems. — Author's abstract

Hardee, Jack. *See* McCoy, H. J. 03913

03994 **Hardy, H. Reginald, Jr.; Kim, Y. S.** A clamp-on strain transducer for use on geologic materials: Soc. Petroleum Engineers Jour., v. 10, no. 1, p. 41-50, illus., table, 1970.

The design, calibration and application of a clamp-on type strain transducer for the simultaneous monitoring of axial and transverse strain under both uniaxial and triaxial test conditions is described. The transducer attaches directly to the test specimen and utilizes a number of linear variable differential transformers to provide average strain data. Tests have been carried out on specimens of a number of metallic (steel, brass and aluminum) and geologic materials (granite, limestone and sandstone) at confining pressures of up to 5,000 psi. No difficulties are contemplated in using the transducer at confining pressures of 10,000 psi and higher. — Authors' abstract

03978 **Harkrider, David G.; Flinn, Edward A.** Effect of crustal structure on Rayleigh waves generated by atmospheric explosions: Rev. Geophysics and Space Physics, v. 8, no. 3, p. 501-516, illus., 1970.

Theoretical seismograms are calculated at a teleseismic distance from atmospheric sources over oceanic and continental Earth models. Vertical surface displacements of the fundamental and first higher-mode Rayleigh waves are obtained for each of the models. Source altitudes range from 0.3 to 4.88 km for a 1-kiloton nuclear explosion in a stratified thermal atmosphere. At 20-sec period, an explosion over the oceanic model exhibits amplitudes an order of magnitude greater than the equivalent amplitudes from an explosion of the same burst height and yield over any of the three continental structures. If the differences in anelastic attenuation over the paths are included, this effect will be reversed at large enough distances. — Authors' abstract

Harkrider, David G. *See* Ben-Menahem, Ari. 04339

Harmer, Richard S., 3d. *See* Cescas, Michel P. 03934

03918 **Harper, Christopher T.** Graphical solutions to the problem of radiogenic argon-40 loss from metamorphic minerals, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 119-140, illus., table, 1970.

The geologic interpretation placed on K-Ar model ages depends on the particular diffusion model adopted. Various possible models are compared graphically using Ar-40 growth curves. Where the same concentration of post-metamorphic radiogenic Ar-40 has been lost from a suite of cogenetic metamorphic minerals irrespective of their K content, analyzed samples yield an isochron with negative intercept on an Ar-40 versus K concentration plot. The K-Ar isochron age, obtained from the slope of such an isochron, is the K-40 retention age which is identified with the age of metamorphic recrystallization. The concentration of Ar-40 lost from the mineral suite is obtained from the negative intercept of the isochron on the K-Ar axis. Relations between K-Ar model ages and K-Ar isochron ages are illustrated by means of regression lines. — GV

04414 **Harrill, J. R.** Determining transmissivity from water-level recovery of a step-drawdown test, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C212-C213, 1970.

A modified form of the Theis recovery formula provides a means of computing transmissivity from the water-level recovery of a step-drawdown test. This variation of the recovery-test technique is designed primarily for use where no observation wells are available and where it is not feasible to schedule a separate recovery test in addition to a step-drawdown test. — Author's abstract

04343 **Harris, E. E.** Reconnaissance bathymetry of Pyramid Lake, Washoe County, Nevada: U.S. Geol. Survey Hydrol. Inv. Atlas HA-379, scale 1:62,500, text, 1970.

From 1909-1968, altitude of the level of Pyramid Lake declined from 3,869 to 3,789 feet above sea level, or 80 feet in 59 years. In addition to fathometer and hand soundings, aerial photography provided details on the present shoreline configuration of the lake; fathometer profiles and aerial photographs were used to contour the lake bottom. Area and volume of the lake at given altitudes are tabulated. As the lake recedes, one island has become connected to the shore by a narrow neck of land, and another is approaching that position. — MCM

04409 **Harris, J. W.; Milledge, H. J.; Barron, T. H. K.; Munn, R. W.** Thermal expansion of garnets included in diamond: Jour. Geophys. Research, v. 75, no. 29, p. 5775-5792, illus., tables, 1970.

The lattice parameters of two garnet inclusions in diamonds, measured by X-rays as functions of temperature, are smaller in the garnets in place than in the same garnets freed from their hosts, indicating that they were under pressure in the diamonds. Pressures in place are estimated from an equation of state for garnet calculated from thermoelastic data — 2-15 kb for one garnet and 2-7 kb for the other. Using a model which assumes that under uniform isotropic stress and temperature diamond forms around garnets and behaves purely elastically thereafter, theoretical values are calculated for the difference in lattice parameters of free and included garnet. Comparison of the experimental and theoretical results provides information on the conditions of formation of diamond and raises questions relevant to the subsequent history of the diamonds. Suggestions are made for further experimental work. — DBV

Harris, R. F. *See* Sommers, L. E. 04061

03798 **Harrison, David L.** The world of American caves: Chicago, Ill., Reilly and Lee Books (a division of Henry Regnery Co.), 152 p., illus., 1970.

Hart, George F. *See* Darrell, James H., 2d. 03822

04364 **Hartronft, B. C.; Smith, M. D.; Hayes, C. J.; McCasland, W.** Engineering classification of geological materials and related soils: [Oklahoma City, Okla.] Oklahoma Highway Dept., 272 p., illus., tables, 1970.

This publication is intended to serve as a comprehensive reference for Highway Dept. personnel concerned with engineering classification of geologic materials in the State. Materials are grouped into geologic units rather than by age, formation, and member. Each unit represents a specific area within a county and identifies and describes geologic materials found therein with the engineering characteristics encountered. The three chapters discuss: (1) general geologic information and procedures, methods for determining engineering characteristics of geologic materials, and a table of geologic terms; (2) geologic units in Division One, consisting of nine counties in east-central Oklahoma; and (3) general soils information for Division One, including soils-geology-slope relations, descriptions and engineering characteristics of soil series, and a table of soil terms. — ESL

Harward, M. E. *See* Chichester, F. W. 04278

Hasadsri, T. *See* Buravas, S. 04368

04338 **Hastie, L. M.; Savage, J. C.** A dislocation model for the 1964 Alaska earthquake: Seismol. Soc. America Bull., v. 60, no. 4, p. 1389-1392, illus., tables, 1970.

Data on displacements due to the 1964 Alaska earthquake have been used to obtain estimates of the extent and attitude of the fault surface involved in the movement and of the amount and direction of relative slip between the two sides of the fault. An "optimal" dislocation surface reasonably fitting the observed surface displacement field was found by a least-squares procedure. The major fault is calculated to be a thrust fault with some left-lateral movement. Results show that even with a far from optimal distribution of data, fitting of a dislocation model to the local displacement field of the Alaska earthquake gives estimates of fault parameters which are otherwise unobtainable, and the estimated attitude of the dislocation plane agrees well with the plane obtained from nodal-plane analysis. — DBV

04029 **Hatch, N. L., Jr.; Stanley, R. S.; Clark, S. F., Jr.** The Russell Mountain Formation, a new stratigraphic unit in western Massachusetts: U.S. Geol. Survey Bull. 1324-B, p. B1-B10, illus., 1970.

A thin discontinuous unit of calc-silicate granulite and quartzite has been mapped on the east limb of the Berkshire anticlinorium in southern Massachusetts and is here named the Russell Mountain Formation. It overlies rocks continuous with the

Hawley Formation of Middle Ordovician age and underlies the Goshen Formation of Middle Silurian to Early Devonian age. Largely on the basis of a correlation with the Shaw Mountain Formation of Vermont, the Russell Mountain Formation is assigned a Middle Silurian age. — NLH

04357 **Hatcher, Robert D., Jr.** Geology of the Long Creek soapstone body, Oconee County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 14, no. 2, p. 49-55, illus., tables, 1970.

This deposit near the Chattooga River occurs in Precambrian rocks of the Blue Ridge Province northwest of the Brevard cataclastic zone. With closely associated pegmatites it appears to be localized at or near the contact between basement rocks and the overlying Late Precambrian(?) metasediments of the Whetstone Group. This soapstone body appears to be homogeneous, its mineralogy suggestive of a complex history of intrusion, alteration, retrogression, and progressive metamorphism, with a complex paragenesis for the assemblage. From bulk chemical composition, its mineral composition, and textural relation between representative constituents, it is considered to be an altered dunite, intruded perhaps in tabular form; its alteration is related to initial cooling, pegmatite intrusion, and regional metamorphism. Conservative reserves of 180,000 tons may be greater if the body is a plug. — GDC

Hatcher, Robert D., Jr. *See* Acker, Louis L. 04358

04270 **Hawks, William L.** Test data for New Mexico clay materials — Pt. 1, Central New Mexico (Bernalillo, Los Alamos, Sandoval, and Santa Fe Counties): New Mexico Bur. Mines and Mineral Resources Circ. 110, 37 p., illus., tables, 1970.

Since the late 1930's approximately 65 samples of clay materials have been collected and tested by various investigators in the area of Bernalillo, Los Alamos, Sandoval, and Santa Fe Counties. Most of the accumulated data is here published for the first time. The area has three operating ceramic-product plants, all in Bernalillo County. The principal products are brick, wall tile, and portland cement. Brick clays are currently being mined from the Madera Limestone near Cedro and the Mancos Shale in Cerillos. Other deposits that show promise of commercial possibilities are Mancos shales at Tonque and Placitas, shales from the Sandia and Abo Formations near Sandia Park, shales in the Mesaverde Formation near Coyote, and a fire clay in the Morrison Formation near San Ysidro. — Author's abstract

Hayes, C. J. *See* Hartronft, B. C. 04364

04031 **Hayes, Philip T.** Cretaceous paleogeography of southeastern Arizona and adjacent areas: U.S. Geol. Survey Prof. Paper 658-B, p. B1-B42, illus., 1970.

An imperfect picture of Cretaceous events is recorded in the rocks of southeastern Arizona and adjacent areas. These events are erosion of mountains and local volcanism during Neocomian time, continental and marine sedimentation in Aptian and Albian time, regional tilting in Albian and Cenomanian time that caused major shifts in shorelines, compressional tectonism in Turonian time followed by erosion, local continental sedimentation in early Campanian time, and widespread volcanism in late Campanian and early Maestrichtian time followed by plutonism and tectonism. The rocks that record this history — Lower Cretaceous volcanics, Bisbee Group, Fort Crittenden and Salero Formations, and their correlatives in and near the region — are described. Some of these rocks locally contain disseminated copper deposits, some are quarried for limestone, and some are possible hydrocarbon reservoirs. — PTH

03974 **Healy, J. H.; Hamilton, R. M.; Raleigh, C. B.** Earthquakes induced by fluid injection and explosion, *in* Earthquake mechanics (T. Rikitake, editor), a symposium, Madrid, Spain, 1969: Tectonophysics, v. 9, nos. 2-3, p. 205-214, illus., 1970.

Earthquakes generated by fluid injection near Denver, Colorado, are compared with earthquakes triggered by nuclear explosion at the Nevada Test Site. Spatial distributions of the earthquakes in both cases are compatible with the hypothesis that varia-

tion of fluid pressure in preexisting fractures controls the time distribution of the seismic events in an 'aftershock' sequence. We suggest that the fluid pressure changes may also control the distribution in time and space of natural aftershock sequences and of earthquakes that have been reported near large reservoirs. — Authors' abstract

Heard, H. C. *See* Stephens, D. R. 04127

Heath, Stanley A. *See* Kesler, Stephen E. 03782

03773 **Hedge, Carl E.; Peterman, Zell E.** The strontium isotopic composition of basalts from the Gordo and Juan de Fuca Rises, northeastern Pacific Ocean: Contr. Mineralogy and Petrology, v. 27, no. 2, p. 114-120, illus., table, 1970.

The strontium isotopic compositions have been determined for 12 tholeiitic basalts dredged from the Gordo and Juan de Fuca Rises. Sr-87/Sr-86 ratios range from 0.7012 to 0.7031 and average 0.7026. These data, combined with other data from the East Pacific Rise indicate that tholeiitic basalts being erupted along the active rises, in the Pacific Ocean, contain less radiogenic Sr-87 than basalts erupted on the islands. These isotopic differences between the ocean-ridge tholeiite and the more alkali island basalts indicate that variations in Rb/Sr have persisted in the mantle for billions of years. The possible origins and distribution of these heterogeneities are discussed. — Authors' abstract

Hedge, Carl E. *See* O'Neil, James R. 03792

04003 **Hedges, Lynn S.; Koch, Neil C.** Geology and water resources of Campbell County, South Dakota — Pt. 3, Basic data: South Dakota Geol. Survey Bull. 20, 172 p., illus., tables, 1970.

This report contains all basic data collected during the course of the investigation of Campbell County and provides the framework upon which the interpretive reports (Pt. 1, geology; Pt. 2, water resources) are based. The basic types of information are: well inventory data, water-level measurements from observation wells, chemical analysis of samples from selected wells, and lithologic logs of wells and test holes. — *from* Author's introduction

03793 **Hedman, E. R.** Mean annual runoff as related to channel geometry of selected streams in California: U.S. Geol. Survey Water-Supply Paper 1999-E, p. E1-E17, illus., tables, 1970.

Channel geometry of 48 gaged streams in California where mean annual runoff is known was studied in 1967 and 1968. Analyses show that mean annual runoff is related to selected dimensions of channel geometry. Width and average depth of the cross section between bars or berms can be used to estimate annual runoff from ungaged streams. Separate relations are needed for perennial and ephemeral streams. Analyses also show it is better to measure several cross sections, compute discharge for each cross section, and average these discharges to obtain discharge for the site. A 10-year period, 1958-67, was analyzed to determine if channel dimensions were affected by recent hydrologic or climatic events. It was determined that computed runoff represented a long-term mean; that is, the standard error of estimate was less for the regression using runoff for the period of record rather than for the 10-year period. — *from* Author's abstract

Heins, R. W. *See* DeGeoffroy, J. 03988

Helgesen, John O. *See* Karner, Frank R. 03876

04366 **Helgeson, Gaylord A.; Ross, Donald S.** Remote sensor imaging for oceanography: Oceanology Internat., v. 5, no. 9, p. 20-25, illus., 1970.

Satellite photography of huge areas of ocean and coastline has made it possible to distinguish major currents, extensive areas of sediment effluents, major topographic

bottom configurations in shallow waters, color changes which indicate biological content, and many other oceanographic phenomena. The authors discuss airborne and satellite photographic sensing, and related television systems, for surface and subsurface oceanographic imagery. Recent experiments using film with various spectral sensitivities are described. — EH

04318 **Helgeson, Harold C.** Reaction rates in hydrothermal flow systems: Econ. Geology, v. 65, no. 3, p. 299-303, 1970.

An idealized rate function for the incongruent reaction of aqueous solutions with feldspar in hydrothermal flow systems permits approximation of the minimum flow rates and mean velocities required for long distance travel of acid vein solutions through fractures in granitic rocks at elevated temperatures. Provisional calculations indicate that such solutions may travel long distances through reactive fractures greater than one mm wide in response to small pressure drives before becoming "neutralized." The calculations suggest that the minimum time required for isothermal deposition of major ore deposits is of the order of a thousand or ten thousand years, depending on the temperature and geometry of the veins. — Author's abstract

Heller, S. J. *See* Wershaw, R. L. 04086

04279 **Henderson, G. V.; Bradley, W. F.** Rectorite and the rectorite-like layer structures [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 2, p. 115-119, illus., 1970.

Analyses of X-ray diffraction data from regularly and nearly regularly alternating structures like rectorite provide opportunity for a discussion of their nature. MacEwan-transform-based analyses have uniformly shown higher incidence of unlike adjacent layers than expected from random distribution. Continuous Fourier transforms for pairs of 2:1 layer silicate structures evaluated normal to layers, provide a family of similar curves that are differently stretched out in reciprocal space for different assumed intervals between two members of a pair. For each exactly alternating example, relative amplitudes of ordered reciprocal nodes distinguish instances for which fixed interlayer populations are Na^+ from those for which they are K^+. For sequences not exactly alternating, scattering maxima are displaced from exact incremental positions in conformity with Hendricks and Teller mixing functions, but relative intensities of adjacent observations still distinguish alkali identities. — *from* Authors' abstract

04145 **Henderson, William A., Jr.** Building a one-circle optical goniometer: Mineralog. Rec., v. 1, no. 2, p. 56-57, illus., 1970.

Most micromounters possess two of the three components needed to make a one-circle optical goniometer — a light source and a telescope or microscope. The third, an arrangement for rotating a crystal and measuring the angle of rotation is easily constructed. For holding and rotating the crystal or micromount box, mount a wooden dowel to turn through close fitting holes in two blocks of wood; on one end of the shaft, glue a small tray in which a lump of roofing compound or clay can be molded to hold the specimen in the right position; on the other end glue a plastic protractor so that its center coincides with center of the shaft. As it is turned the protractor rotates past a marker line drawn on the base of the goniometer, which is mounted on faucet washers for more stability. Seven steps necessary in using the goniometer in order to get good results are described. — GDC

04146 **Henderson, William A., Jr.** Bavenite from Connecticut: Mineralog. Rec., v. 1, no. 2, p. 70-71, illus., 1970.

Bavenite was first described from Italy (Artini, 1901), as a monoclinic, hydrated calcium aluminum silicate. A later reported pseudomorphic alteration product after beryl, from California, was found to be a beryllium mineral. Switzer and Reichen (1960) indicate in their composition that beryllium and aluminum proxy for each other in tetrahedral coordination. Incorrectly described in 1876 under the name of pilinite, the name of bavenite is retained. It occurs in granites and granitic peg-

matites, chiefly as an alteration product of beryl, but also rarely in alpine veins. The bavenite described here, a second find from Haddam, Connecticut, was identified from its X-ray powder pattern; it occurred in a black tourmaline-feldspar-quartz pegmatite in gneiss. One superb specimen consisted of crystals so large they have the pale, apple-green color of prehnite. — GDC

Hertlein, Leo G. *See* Zullo, Victor A. 03797

04245 **Herz, Norman; Valentine, L. B.** Rutile in the Harford County, Maryland, serpentinite belt, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C43-C48, illus., tables, 1970.

Rutile occurs in an ultramafic chlorite rock of the serpentinite belt of Harford County, Md; at one prospect it is in pockets that contain as much as 16 percent rutile, together with magnetite and apatite. The serpentinite lens that includes the prospect, 300 feet wide and 7,000 feet long, trends NE, parallel to the strike of the regional schistosity. The rutile may have formed during low-grade regional metamorphism when metasomatic exchanges took place between the serpentinite and enclosing Wissahickon Formation. Analyses of six bedrock and nine stream sediment samples show a maximum value of 5 percent for rutile in hard-rock samples at the prospect and 2 percent in stream concentrates 1.3 miles SW. Magnetite content is 33.5 percent at the prospect and reaches a maximum of 90 percent in a panned stream concentrate 3.5 miles NE. The lens can be considered a potential economic source for rutile and magnetite. — *from* Authors' abstract

03809 **Higgins, Gary H.** Summary of nuclear explosion data for underground engineering applications — UCRL-50853: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., 7 p., tables, 1970.

Forty-five events conducted by the United States for a variety of programmatic purposes were selected for inclusion in this summary. Pertinent data were collected for these events, including depth of burst; depth to water table; depth to Paleozoic rock formation; medium of explosion; yield of the event; cavity radius formed by expansion of the rock; chimney height formed above the detonation point; and the purpose of the nuclear detonation. Also prepared were summary tables of the generalized characteristics of a variety of rocks, the quantity of rock vaporized and melted, and the preshot/postshot permeability of rock from four events: Handcar, Hardhat, Pile Driver, and Salmon. — Author's abstract

High, Lee R., Jr. *See* Picard, M. Dane. 04401

Hills, L. V. *See* Gunther, P. 04355

03982 **Hindall, S. M.; Flint, R. F.** Sediment yields of Wisconsin streams: U.S. Geol. Survey Hydrol. Inv. Atlas HA-376, scale about 1 in. to 7 mi., text, 1970.

Highest sediment yields in Wisconsin's glaciated areas are near Lake Superior (northern), and Green Bay and Lake Winnebago (east-central); the Driftless Area (southwestern) has the highest yield. The significance of each soil region and land use and cover to sediment yield is discussed briefly. Average concentration of sediment for the 44 sampled sites is 157 mg/l, which is low in comparison to the United States in general. Recommendations are made for additional studies. — MCM

04136 **Hinds, Robert W.** Ordovician Bryozoa from the Pogonip Group of Millard County, western Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 1, p. 19-40, illus., tables, 1970.

Six new species of bryozoans are described from the Middle Ordovician Kanosh Shale and Lehman Formation of the Pogonip Group. Owing to scarcity and poor preservation, only two are formally named: the cryptostome *Phyllodictya crystalaria*, restricted to the upper Lehman; *Dianulites utahensis*, the only trepostome that ranges from the Kanosh into the Lehman. The trepostome *Nicholsonella* sp. A, the oldest species found in the region, occurs in the lowest part of the Kanosh Shale; all the

other trepostomes, including those designated as species A of *Batostoma*, *Eridostrypa*, and *Amplexopora*,, first appear in the middle or upper Kanosh. Other amplexoporids, eridotrypids, and batostomids, represented in the Kanosh by young zooecial features only, are not described here. — VMJ

Hiscott, T. *See* Given, P. H. 04091

04185 **Hobson, G. D.; Speers, G. C.** (editors). Advances in organic geochemistry — Internat. Cong., 3d, London, 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), 576 p., illus., tables, 1970.

This third International Congress on Organic Geochemistry was organized (as were the first two congresses) by the European Branch of the Organic Geochemistry Group of the Geochemical Society. The proceedings comprises 34 papers, 12 of which are cited separately. — VSN

04283 **Hoffman, David J.** Relation of magnetite content to geology at Queco: Econ. Geology, v. 65, no. 4, p. 511-512, 1970.

The coincidence of structural and metamorphic maxima, characteristic of iron deposits of the southern Labrador Trough in Quebec is consistent with data from Queco. "Structural determination of iron mineralogy, with coarse specular hematite at the node of structural and metamorphic maxima is indicated and further implies that at the Carrot Lake (western) end of the main property, the geologically favorable keel of the syncline or synclinorium is near surface. Conversely silicates and carbonates at the Bloom Lake (eastern) end suggest that the nodes there are much deeper. Perhaps the geographic zoning, mentioned by Murphy (1959), is related to a geographic variation of deformation intensity and/or present exposure patterns, rather than to primary depositional facies." — VSN

04011 **Hofmann, Albrecht; Giletti, Bruno J.** Diffusion of geochronologically important nuclides in minerals under hydrothermal conditions, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 141-150, illus., table, 1970.

The isotopic exchange of Rb, Sr, and K between a natural biotite and a hydrothermal solution has been studied at 550°, 650°, and 700° C at 2 kb pressure. Both equilibrium and kinetics have been investigated. Alteration of mica was always minor and did not vary appreciably between runs buffered for oxygen fugacity and those sealed in gold tubes with no buffer introduced. The equilibrium value P_{H_2O} was found to be 0.82 ± 0.05 at these temperatures. The diffusivity for K was approximately the same as that for Rb. The appearance of a Sr-rich phase prevented the accurate determination of a Sr diffusivity but the diffusivity for the radiogenic Sr as well as for Na was similar to that for Rb within one order of magnitude. — GV

Holden, John C. *See* Dietz, Robert S. 03963

Holroyd, M. T. *See* Bhattacharyya, B. K. 04288

03801 **Honduras Instituto Geográfico Nac.** Mapa geológico de Honduras – San Juan de Flores (Hoja 2758 I G): Tegucigalpa, Honduras, Ministerio de Comunicaciones y Obras Publicas, scale 1:50,000, 1970.

Hope, R. C. *See* Delevoryas, T. 04155

04018 **Hopper, Margaret G.; Bollinger, G. A.** A note on the central Virginia earthquake of December 11, 1969: Earthquake Notes, v. 41, no. 2, p. 31-36, illus., table, 1970.

Epicentral location and origin time were found using arrival time data from six regional stations. The epicenter as calculated by VPI and by the USCGS differed by about 30 miles. These differences are probably due to (1) lack of azimuthal station control, (2) inadequacy of the present knowledge of variations in crustal velocity and/or structure for the area, and (3) differences in the models used in calculations.

The epicenters were 37.9° N-77.7° W (VPI) and 37.8° N-77.4° W (USCGS). Origin times were 23:44:38.7 (VPI) and 23:44:39.2 (USCGS). A magnitude of 3.5 was found using the BLA record. Results of an intensity questionnaire survey indicated a maximum intensity of IV and a felt area of approximately 6,500 sq mi in central Virginia. Also, a possible "halo" effect was implied by several isolated felt reports. — *from* Authors' abstract

03823 **Hoppin, Richard A.** Structural development of Five Springs Creek area, Bighorn Mountains, Wyoming: Geol. Soc. America Bull., v. 81, no. 8, p. 2403-2415, illus., geol. map, 1970.

The Five Springs thrust trends northwestward along the soutwestern side of the north end of the Bighorn Mountains, and involves Precambrian crystalline and Paleozoic and Mesozoic sedimentary rocks. Near its southeastern end the thrust turns northeastward and becomes a left-hand strike-slip fault that cuts into basement rocks of the Bighorn Mountains. At its northwestern end the thrust turns westward and becomes a left-hand strike-slip fault that cuts young rocks of the Bighorn Basin. These relationships indicate that the northwestern part of the thrust is underthrust, and that the southeastern part is overthrust. A faulted monocline with overturned beds in the southwestern limb lies parallel to and about one mile northeast of the thrust. Structures in the Precambrian rocks indicate that the basement rocks were deformed by block tilting. — WHN

04248 **Hosterman, John W.; Wood, Gordon H., Jr.; Bergin, M. J.** Mineralogy of underclays in the Pennsylvania Anthracite region, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C89-C97, illus., table, 1970.

The underclays of anthracite beds in eastern Pennsylvania contain kaolinite, illite (2M), chlorite, pyrophyllite, and phlogopite, all identified by X-ray diffraction; quartz is the only nonclay mineral. The association of these clay minerals indicates that the anthracite formed in the greenschist range of temperateure and pressure; that is, between 250° and 450°C and 2,000 to 9,000 bars, respectively. — Authors' abstract

04257 **Houston, Robert S.; Murphy, John F.** Thorium- and titanium-bearing organic material in the Dakota Sandstone near Durango, Colorado, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C138-C144, illus., tables, 1970.

Organic material similar to thucholite, in Dakota Sandstone north of Durango, Colo., resembles asphaltite, but chemical analyses suggest it was derived from coal or humic substances. It is enriched in Th and Ti, but also contains anomalous Au, U, Nd, Zr, Yb, Y, V, Sr, La, Cr, Cu, Ba, and Ce. Because of variable chemical properties of elements enriched in the organic material and tendency of certain elements such as Th, Ti, and Zr, to precipitate with the hydrolyzates, it is unlikely that these elements would be transported in a single ionic solution to the organic material where they could be absorbed to form thucholite. It is suggested that ground water carried humic substances in solution or as colloidal suspensions through the Dakota Sandstone and these substances adsorbed the various elements from local interstitial solutions or surface films on minerals of the sandstone. — *from* Authors' abstract

03968 **Houtz, R.; Ewing, J.; Buhl, P.** Seismic data from sonobuoy stations in the northern and equatorial Pacific: Jour. Geophys. Research, v. 75, no. 26, p. 5093-5111, illus., tables, 1970.

Sonobuoy stations from the North Pacific have yielded 470 velocities, determined about equally from reflection and refraction data. Refraction velocities are corrected for dip and tabulated with layer thicknesses. Interval velocities (also corrected for dip) from sedimentary layers of the northern Pacific are plotted against one-way traveltimes and reveal characteristic velocity curves from various areas of the Pacific. Velocity of the opaque layer in the northwest Pacific is about 3.0 kmps, nearly double that of sediments at comparable depths elsewhere in the Pacific. Preliminary studies from the Bering Sea indicate that human errors have little effect

on such plots. Sonobuoy refraction data from areas of the Pacific where the basement appears to be smooth, reveal that the smooth material is sometimes several hundred meters thick and has a less than typical velocity. There are many areas where it may be less than 4.0 kmps. — DBV

04120 **Howard, L. N.; Malkus, W. V. R.; Whitehead, J. A.** Self-convection of floating heat sources — A model for continental drift: Geophys. Fluid Dynamics, v. 1, nos. 1-2, p. 123-142, illus., 1970.

In the first of two models of floating heat sources, the motion of two line heat sources constrained to float at an arbitrary depth in a viscous fluid is determined in the limit of small convection velocities; the sources drift apart and at great separation attain a constant velocity proportional to the square root of the heat flux. The second model, a floating block heat source presumed to be very long compared to its depth, is found to exhibit periodic excursions between the end walls of the fluid container with the same dependence of velocity on heat flux as the line sources. A series of experiments are described which exhibit various features of the theory. Numerical values found when the theory is applied to the Earth suggest the idealized flows may be useful in interpretation of continental drift. — *from* Authors' abstract

04360 **Howell, Paul W.** The mystery of Death Valley's Race Track playa: Geol. Soc. Oregon Country News Letter, v. 36, no. 8, p. 58, 1970.

The Race Track playa, in a northern sidebranch of Death Valley is famous because of the tracks on its surface, usually attributed to wind-blown rocks. The author spent an evening and a morning walking over the playa studying the tracks, and was impressed by the fact that so many tracks had no rocks, some increased in width as they went, and all had an accumulation of mud curls at the end. The author suggests that ice cakes forming in pockets on the playa, then freed by a rainstorm, would make such tracks. Ice forming under rocks would also account for their moving. — ESL

03961 **Hoyaux, B.; Ladanyi, B.** Gravitational stress field around a tunnel in soft ground — Reply [to discussion of 1970 paper by B. Schmidt]: Canadian Geotech. Jour., v. 7, no. 3, p. 348, 1970.

The original paper was published, ibid., v. 7, no. 1, p. 54-61, 1970; *see* Abs. North American Geology, February 1971. This reply follows the discussion by Schmidt in the present issue, p. 346-348. — GDC

Hubbard, E. F. *See* McMaster, W. M. 04425

Hubert, Arthur E. *See* Curtin, Gary C. 04255

04287 **Huckenholz, H. G.; Yoder, H. S., Jr.** Synthese und Stabilität von Andradit [Synthesis and stability of andradite] [abs.]: Fortschr. Mineralogie, v. 48, no. 1, p. 8-9, 1970.

Hudson, J. A. *See* Brown, E. T. 04351

Huggins, F. G. *See* King, H. W. 04135

04396 **Hughes, Charles J.** The Late Precambrian Avalonian orogeny in Avalon, southeast Newfoundland: Am. Jour. Sci., v. 269, no. 2, p. 183-190, 1970.

The Avalonian orogeny, in its type area of the peninsula of Avalon, southeastern Newfoundland, comprised the construction of an elongate volcanic island belt composed entirely of calc-alkalic lavas, pyroclastics, and derived sediments; intrusion by penecontemporaneous high-level granitic rocks; and rapid erosion to sea level accompanied by vertical faulting. Features indicative of compression are absent or subordinate. The analogy to island arc volcanism, suggested by several previous workers, new seems to be stronger. — Author's abstract

04087 **Hunt, John M.** The significance of carbon isotope variations in marine sediments, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson

and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 27-35, illus., table, 1970.

The C-isotopic composition of organic matter in sediments of 32 rivers along the U.S. Atlantic Coast was studied and compared with that in continental shelf and slope sediments. Results indicate: (1) There is enrichment in δC-13 of 6 per mil of organic matter in sediments of most small rivers from 10 mi upstream to river mouth; values comparable to deep-sea sediments occur within a few miles offshore. (2) Bays have δC-13 values comparable to deep-sea sediments as far as 50 mi upstream. (3) Sounds enclosed by long sand bars show a 1 to 2 per mil depletion in C-13 over deep-sea sediments; rivers feeding into these sounds show terrestrial values. (4) Relic terrestrial sediments, not covered since land was emergent, have values comparable to deep-sea sediment except in compact peat beds which have terrestrial values. (5) Samples from drillholes off Florida show values greater than -25 per mil at depths over 500 feet in contrast to surface values around -20 per mil. — VSN

Hurley, Patrick M. *See* Fairbairn, Harold W. 03922

Hutton, M. A. *See* Bott, M. H. P. 03938

Imbalzano, J. *See* Given, P. H. 04091

Ingle, James C., Jr. *See* Bandy, Orville L. 04388

04400 **Ishii, Hiroshi; Ellis, Robert M.** Multiple reflection of plane P and SV waves by a dipping layer: Royal Astron. Soc. Geophys. Jour., v. 20, no. 1, p. 11-30, illus., 1970.

The problem of plane P and SV waves incident at the base of a dipping layer and perpendicular to the strike is investigated by a technique which expresses the reflection and refraction coefficients in terms of propagation direction of the incident wave in a cylindrical co-ordinate system. It is shown that all multiply reflected waves can be calculated by this scheme. For both incident P and SV waves, numerical values of the displacements and displacement ratios are calculated on the surface. It is found that displacement ratios for incident SV waves are much more sensitive to dip than are those for incident P waves. For P and SV waves propagating in the down-dip direction, the amplitude ratio versus frequency curves for constant depth to the interface do not have significant peaks for dip angles greater than 15°. Displacement discontinuities resulting from the geometric nature of the wave solution are also calculated. — *from* Authors' summary

04051 **Itagaki, K.** X-ray topographic study of vibrating dislocations in ice under an AC electric field, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 526-538, illus., table, 1970.

Slices of single ice crystals produced in the Mendenhall Glacier were mounted on the goniometer head, and Lang diffraction topography was made. It was possible to distinguish dislocations vibrating under the electric field. Causes which seem to prevent dislocation line motion are discussed. — ESL

04259 **Izett, G. A.; Denson, N. M.; Obradovich, J. D.** K-Ar age of the lower part of the Browns Park Formation, northwestern Colorado, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C150-C152, illus., tables, 1970.

Biotite separated from the chalky-white rhyolitic ash in the lowermost part of the Browns Park Formation in northwestern Colorado has a K-Ar age of 24.8 ± 0.8 million years. On the basis of combined radiometric (early Miocene) and paleontologic (late Miocene) evidence, the age of the Browns Park ranges from earliest Miocene through most of Miocene and possibly into early Pliocene time. — Authors' abstract

04286 **Jackson, E. D.** The origin of ultramafic rocks by cumulus processes [abs.]: Fortschr. Mineralogie, v. 48, no. 1, p. 9-10, 1970.

Jackson, Everett D. *See* O'Neil, James R. 03792

04350 **Jackson, Everett D.; Wright, Thomas L.** Xenoliths in the Honolulu Volcanic Series, Hawaii: Jour. Petrology, v. 11, no. 2, p. 405-430, illus., tables, 1970.

Rocks of the Pleistocene to Holocene series exhibit compositional zoning relative to rocks of the older Koolau tholeiite shield. Xenoliths are also zoned, but the zoning does not coincide with that of the enclosing rocks, suggesting lateral and vertical heterogeneity in the upper mantle beneath Oahu, caused by extensive melting of the material from which the tholeiitic magma was generated. Generation of the Honolulu magmas probably took place at greater depth than the Koolau magmas, presumably as a result of elastic unloading. — MS

04021 **Jackson, Kern C.** Textbook of lithology: New York and London, McGraw-Hill Book Co., 552 p., illus., tables, 1970.

The course level at which this text is aimed should have as prerequisites general geology, mineralogy, and college chemistry. The material covers magmatic, sedimentary, and metamorphic processes; and igneous-, sedimentary-, and metamorphic-rock petrography. Fundamentals of phase relationships are appended. — MCM

04274 **Jacoby, Wolfgang R.** Instability in the upper mantle and global plate movements: Jour. Geophys. Research, v. 75, no. 29, p. 5671-5680, illus., 1970.

It is shown that the upper mantle is probably unstable. The instability expresses itself in diapirism under the ridges and sinking of the lithosphere under the island arcs. Both processes exert a force on the plate that can move it against the viscous drag from the flow of the asthenosphere. Order of magnitude estimates of the forces and of the required energy demonstrate that the process is plausible and that the drift rate can be determined from the resistance the plate encounters at its edges,particularly below the island arcs where it plunges into the mesophere. The proposed mechanism can be tested by studying, for example, the deep structure of the ridges, the stress field in the plates, and the gravity field over ridges and trenches. — Author's abstract

Jaeger, Herman. *See* Churkin, Michael, Jr. 03873

03944 **Jarrett, P. M.; Eden, W. J.** Groundwater flow in eastern Ottawa [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 326-333, illus., tables, 1970.

A mile-long line of piezometers were installed at various depths in a clay terrace system east of the City of Ottawa [Ontario]. Measurements indicated a significant downward piezometric gradient through the clay layer to the underlying bedrock. The downward flow of water through the clay affects both existing effective stresses and the stress history of the clay deposit. — Authors' abstract

Jaworowski, R. J. *See* Lublin, P. 04128

Jeletzky, J. A. *See* Muller, J. E. 04440

04166 **Jennings, J. R.** A lycopod from the Salem Limestone (Mississippian) of Illinois [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 756, 1970.

04210 **Jensen, James A.** Fossil eggs in the Lower Cretaceous of Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 1, p. 51-65, illus., 1970.

The oldest known fossil eggshells from North America are reported from equivalent basal Cretaceous beds at localities 145 miles apart in Utah — the Cedar Mountain Formation near Castle Dale and the Kelvin Formation east of Coalville. The shell fragments apparently represent several kinds of reptiles and possibly birds and are more varied in external ornamentation and complex in microstructure than Late Cretaceous eggshells reported from Utah (Jensen, 1966). Microstructure is much more complex than in modern birds, consisting of many layers with framework of protein fibers, distinctly divided into an upper prismatic zone and a lower (inner) prismatic zone. One distinctly ornamented variety is here named *Oolithes carlylensis*,

n.sp., following the generic designation of C. C. Young (1955) for fossil eggs of unknown vertebrate parentage. — VMJ

03854 **Johansen, Nils I.; Melhorn, Wilton N.** Proposed origins for the Hadley Lake depression, Tippecanoe County, Indiana: Indiana Acad. Sci. Proc. 1969, v. 79, p. 270-280, illus., 1970.

An unusual linear topographic depression in northwestern Tippecanoe County, Ind., contains Indian Creek, Hadley Lake, a branch of Burnett Creek, and a reach of the Wabash River. Hypotheses presented for origin and development of the depression are: (1) a partly abandoned glacial sluiceway; (2) an esker trough or *rinnentaler*; (3) a segment of the "original" Wabash River channel; and (4) stream capture. It is concluded that hypotheses 1 and 4 may be combined to provide a reasonable solution to the problem; hypothesis 2 is an exciting possibility and hypothesis 3 is not totally implausible. Additional fieldwork, particularly shallow exploration geophysical methods to determine bedrock configuration and altitude, is needed to verify one or a combination of hypotheses, or provide evidence that none are reasonable explanations. — *from* Authors' abstract

Johnson, A. I. *See* Teasdale, W. E. 04307

Johnson, G. R. *See* Anderson, L. A. 04251

04052 **Johnson, Gerald G., Jr.; Chan, Frank L.** An approach to the solid solution problem using a computerized identification technique, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 539-549, 1970.

Since solid-solution effects influence position and intensity of the X-ray diffraction pattern, an automatic system is needed which will identify standard reference phases regardless of the amount of solid solution. Using the system CdS-ZnS, where the lattice parameter a_o changes from 4.136 to 3.820A, with complete solid solution over the range of composition, an illustrative study was made. Results obtained from computer analysis of the powder pattern is presented. The solid solution can be identified if the starting chemistry is known and the end members of the series are in the ASTM Powder Diffraction File. Once the phases present are identified, a plot following Vegard's law yields the approximate composition. These two methods of compositional determination agree quite well. Examples of the computer system, description of the program input and output, with interpretation of results are discussed. — *from* Authors' abstract

Johnson, J. Donald. *See* Dobbins, David A. 03956

04072 **Johnson, S. J.; Dansgaard, W.; Clausen, H. B.; Langway, C. C.** Climatic oscillations 1200-2000 A.D.: Nature, v. 227, no. 5257, p. 482-483, illus., 1970.

Climatic fluctuations during the period in question are worked out on the basis of oxygen isotope measurements made on a 1,400-m surface-to-bottom ice core from Camp Century on the North Greenland ice sheet. The ages of the various increments of core were calculated by considering a simple ice flow model. As the climatic record that resulted from plotting δ 0-18 data against calculated ages reflected known climatic events dated by other methods, the procedure is regarded as successful. — DBV

Johnson, Stephen H. *See* Mooney, Harold M. 04007

04334 **Johnson, Stephen H.; Couch, Richard W.** Crustal structure in the North Cascade Mountains of Washington and British Columbia from seismic refraction measurements: Seismol. Soc. America Bull., v. 60, no. 4, p. 1259-1269, illus., table, 1970.

Seismic waves generated by large chemical explosions at Greenbush Lake, British Columbia, were recorded at 15 stations along two profiles extending across the North Cascade Mts. into western Washington. $T = \Delta/6.13$ expresses the time-distance curve

for P_g: $T = 6.21 + \Delta/7.91$ expresses the P_g arrival time along a line of azimuth of 210.4° out to 519 km; and $T = 6.85 + \Delta/8.06$ expresses the P_n arrival time along a line of azimuth of 223.0° out to 540 km. Calculations based on a 7.96-kmps mantle velocity indicate that the crust thickens toward the south and thins toward the west. Average crustal thickness along azimuth 210.4° is 32 km and along 223.0° is 29 km. Amplitude data suggest a Q value near 384 for upper mantle rocks beneath the North Cascade Mts. — DBV

04290 **Johnson, Thys B.; Mickle, David G.** Optimum design of an open pit, an application in uranium [abs.]: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 443, 1970.

Johnson, Walter E. *See* Selander, Robert K. 03871

03820 **Jolly, Wayne T.** Zeolite and prehnite-pumpellyite facies in south central Puerto Rico: Contr. Mineralogy and Petrology, v. 27, no. 3, p. 204-224, illus., tables, 1970.

Despite shallow burial [about 4 km] the mineralogy of these lavas and pyroclastic rocks has systematically readjusted. The degree of metamorphism is proportional to permeability. The generalized sequence of appearance of secondary phases from low to high rank are as follows: (1) analcime, celadonite, chlorite, and sericite; (2) laumontite and albite; (3) prehnite; (4) pumpellyite; (5) epidote; (6) actinolite. During alteration two major thresholds were crossed. First, calcium-aluminum silicates formed from materials released by decomposition of calcium feldspar. Second, clinopyroxene was decomposed in a process that added considerable mafic material to the reacting system, and made bulk rock compositions approximately equivalent to the composition of the reacting system. — *from* Author's abstract

04202 **Jonasson, I. R.** Mercury in the natural environment, a review of recent work: Canada Geol. Survey Paper 70-57, 39 p., 1970.

A review on mercury in the natural environment is presented to cover the literature published since the last major review which is that of James (1962). Together with the treatise by Saukov (1946) these two earlier works provide a full background on the relevant chemistry and geochemistry of mercury which is not duplicated in this report. Sections on analysis for mercury and its compounds, mercury in natural waters, aspects of pollution by mercury, mercury in soils, and recent advances in the geochemistry of mercury in ores and rocks are included. A bibliography of more than three hundred published papers is included. — Author's abstract

Jones, David L. *See* Bailey, Edgar H. 04418

Jordan, Jane C. *See* Schiffman, Robert L. 04226

03890 **Jung, Peter.** *Torreites sanchezi* (Douvillé) from Jamaica: Palaeontographica Americana, v. 7, no. 42, 12 p., illus., 1970.

A hippurite-rudist, *Torreites sanchezi* (Douvillé), is described and figured from the Campanian Barrettia Limestone of the Green Island Inlier, Hanover Parish, western Jamaica, W.I. It is the first record of the genus outside Cuba. — VSN

Jungels, Pierre. *See* Smith, Stewart W. 04068

04006 **Kanamori, Hiroo.** The Alaska earthquake of 1964 — Radiation of long-period surface waves and source mechanism: Jour. Geophys. Research, v. 75, no. 26, p. 5029-5040, illus., table, 1970.

The records of multiple Love and Rayleigh waves of the Alaska earthquake of 1964 were removed from the 30-100 seismograph records at WWSSN stations. The seismograms were equalized to a propagation distance of $9\pi/2$, and compared with synthetic seismograms (computed from normal mode solutions) for radiation pattern and amplitude to estimate various source parameters. One simple, yet plausible, source model was found: force system, double couple, reverse dip slip; fault plane, dip angle 20°, dip direction N. 24° W.; rupture length, 600 km; rupture velocity, 3.5

kmps towards S. 25° W.; moment 7.5×10^{29} dyne-cm; average slip dislocation, 7 in N. 24°W. direction; stress drop, 28 bars; strain drop, 0.4×10^{-4}; released strain energy, 1.5×10^{25} ergs. The moment and the width of the fault plane are much larger than those of any other earthquakes reported. —*from* Author's abstract

04275 **Kanasewich, E. R.; Agarwal, R. G.** Analysis of combined gravity and magnetic fields in wave number domain: Jour. Geophys. Research, v. 75, no. 29, p. 5702-5712, illus., 1970.

Potential field data have been analyzed in the two-dimensional wave number domain to obtain the ratio of intensity of magnetization to the density (J/ρ). A two-dimensional fast Fourier transform is used to obtain convolution, upward continuation, vertical and horizontal derivatives, and reduction of the total field to the pole. A coherency test is used on the two sets of data to evaluate the validity of the calculated J/ρ ratio for each wavelength. A high-coherency value is assumed to arise if the gravity and magnetic anomalies are caused by the same body. A theoretical prismatic model and a field example from northern Saskatchewan illustrate the techniques. — Authors' abstract

Karklins, Olgerts L. *See* Cressman, Earle R. 03857

03876 **Karner, Frank R.; Helgesen, John O.** Petrologic significance of zircon variation in the Tunk Lake Granite, southeastern Maine: Jour. Geology, v. 78, no. 4, p. 480-498, illus., tables, 1970.

The Tunk Lake pluton of southeastern Maine is concentrically zoned and formed of marginal granite and central quartz monzonite. Zirconium content decreases from 660 ppm in the margins to 170 ppm in the core. Zircon crystals range from 0.24 mm in length in the margins to 0.13 mm in the core. Core zircons are partially metamict, less elongate, and of more complex morphology than margin zircons. Broken and clustered zircons are found only in the margins, and support the author's contentions that zircon distribution was controlled largely by gravity settling and magmatic convection. Zircon characteristics are not reliable in correlating igneous intrusives. — FB

04164 **Kasper, Andrew E., Jr.; Andrews, Henry N., Jr.** A new genus of Devonian plants from northern Maine [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 755, 1970.

Kauffunger, Richard A. *See* Larach, Simon. 04148

Kawano, Minoru. *See* Minato, Susumu. 04406

04417 **Keays, Reid R.; Crocket, James H.** A study of precious metals in the Sudbury Nickel Irruptive ores: Econ. Geology, v. 65, no. 4, p. 438-450, illus., tables, 1970.

Ru, Pd, Os, Ir, and Au were determined in copper-nickel sulfide ores of Strathcona mine and other Sudbury Nickel Irruptive deposits. In Strathcona mine Pd and Au are enriched in footwall and deep ore zone chalcopyrite by factors of 14 and 5, respectively, relative to hanging-wall pyrrhotites; Ru, Os, and Ir reach maximum concentrations in pyrrhotites of the hanging-wall breccia ores. The marked fractionation of precious metals between footwall and hanging-wall ores suggests strong partition between pyrrhotite solid solution and a sulfide melt phase. The relative stability of sulfides and metals of the platinum group as a function of partial pressure of S indicates that Ir, Ru, and Os were present as sulfides in the Strathcona ore melt. Concentration in hanging-wall pyrrhotites suggests low solubility in high-temperature sulfide melts and coprecipitation by early pyrrhotite. —*from* Authors' abstract

Keil, Klaus. *See* Blander, Milton. 04119

Keil, Klaus. *See* Bunch, T. E. 04438

Keith, M. L. *See* Rose, Arthur W. 04310

04408 **Kelleher, John A.** Space-time seismicity of the Alaska-Aleutian seismic zone: Jour. Geophys. Research, v. 75, no. 29, p. 5745-5756, illus., 1970.

Examination of space-time patterns of distribution of major earthquakes of the Alaska-Aleutian seismic zone suggests that they progress from east to west. Past trends suggest that a major earthquake may occur near lat 56° N. long 158° W. between 1974 and 1980. Earthquakes of magnitude 7.7 or larger should be used to identify space-time patterns in this seismic zone. As the pattern is reasonably consistent, linear trends of large earthquakes are probably caused by some physical phenomena. Space-time distribution of epicenters for 1961-67 suggests that past trends will continue for there is a distinct seismicity gap in the region predicted for the next major earthquake and such gaps have often occurred before major earthquakes in the past. Linear trends also appear in space-time distribution of large earthquakes in other circumpacific seismic zones; large earthquakes can be expected in the Commander Islands and northern Kuriles. — DBV

03782 **Kesler, Stephen E.; Heath, Stanley A.** Structural trends in the southernmost North American Precambrian, Oaxaca, Mexico: Geol. Soc. America Bull., v. 81, no. 8, p. 2471-2476, illus., 1970.

Structures observed in a 1000 km² area of Grenville age Precambrian metasediments near Oaxaca in southern Mexico record the effects of a single orogenic event that produced cylindroidal folds about axes with an average bearing of N. 32° W. and plunge of 26° NW. The orientation of this structural grain appears to provide support for previous proposals (based on geochronology) that a structural belt of Grenville age rocks extends southward from Texas into the Oaxaca area. Further interpretations based on these trends suggest that the Pacific boundary of the Oaxacan Precambrian terrane resulted from continental fragmentation and that adjustments associated with opening of the Gulf of Mexico have not reoriented significantly the Oaxaca area. — Author's abstract

04415 **Kesler, Thomas L.** Hydrothermal kaolinization in Michoacán, Mexico [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 2, p. 121-124, illus., table, 1970.

Active kaolinization of middle Tertiary obsidian and rhyolitic breccia in the San Andres Mts. is effected by sulfurous hot waters and hydrous vapors emitted as springs, fumaroles, and geysers. Original rock textures are preserved and conspicuous aureoles form around hydrothermal vents. Systematic exploration by 87 test pits permitted inspection of kaolin in place, and furnished bulk samples for laboratory work. The clay also contains unevenly distributed cristobalite and alunite, and traces of mercury. Natural brightness of pure kaolinite approches 90 if unstained by weathering, but little of it is pure. The yield of paper-coating fraction is small, and the composition and behavior in slurries are nonuniform. Most of the kaolinized material is soft, but some is hard and rock-like. Similar material occurs in late Tertiary sediments, suggesting hydrothermal activity at least as early as Pliocene. — *from* Author's abstract

Kevi, L. *See* Wiebenga, William A. 03986

Kienzlen, Geraldine. *See* McNulty, C. L., Jr. 04131

04370 **Kiesl, W.; Weinke, H. H.** Uber Mangandaubréelith in den Troilitknollen des Odessa-Eisenmeteorits [On the manganese daubréelite in the troilite inclusions of the Odessa-iron meteorite (with English abs.)]: Mikrochim. Acta 1970, pt. 2, p. 392-402, illus., tables, 1970.

Microprobe analyses of troilite inclusions from a sample of Odessa (Texas) iron meteorite have identified manganese daubreelite of composition $(Fe_{0.9}Mn_{0.1})Cr_2S_4$. This composition corresponds to that reported by Keil (1968) for minerals in enstatite chondrites, but this daubréelite occurrence in Odessa is the first reported for an iron meteorite. — VSN

Kim, Y. S. *See* Hardy, H. Reginald, Jr. 03994

04216 **Kim, Young S.; Zeitlin, Harry.** Thorium hydroxide as a collector of molybdenum from sea water: Anal. Chim. Acta, v. 51, no. 3, p. 516-519, illus., tables, 1970.

Experiments with iron(III) hydroxide showed that a second condition besides that of charge may be necessary for collection of a trace species. The collector must contain an ion which forms a compound of low solubility with the counter ion adsorbed. The thorium-hydroxide collector offers the following advantages: enhanced sensitivity and accuracy, and elimination of the need for masking iron(III). The coprecipitate is also less bulky and easier to handle and filter. Aluminum hydroxide is virtually ineffective as a collector of molybdenum due to the high solubility of aluminum molybdate. — ESL

04201 **Kindle, E. D.** Preliminary report on the copper deposits, Coppermine River area, District of Mackenzie: Canada Geol. Survey Paper 70-49, 13 p., table, 1970.

Most copper deposits in the Coppermine River area are either syngenetic or epigenetic. Fourteen classes of deposits are described briefly and certain conclusions drawn concerning the origin of the lode copper deposits. — Author's abstract

04135 **King, H. W.; Gillham, C. J.; Huggins, F. G.** A versatile Bragg-Brentano/Seeman-Bohlin powder diffractometer, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 550-597, illus., tables, 1970.

This interchangeable diffractometer was used in a study of the influence of geometry on resolution, angular displacement, and intensity of diffraction profiles, and demonstrated that the standard Bragg-Brentano method is preferred when recording Bragg reflections below 40°, 2θ. At higher Bragg angles, the diffracted intensity of the Seeman-Bohlin method can be increased above that of the Bragg-Brentano. A study of the effect of specimen setting on systematic errors associated with the Seeman-Bohlin geometry indicates that a setting of 60° gives optimum resolution with minimum displacement error. An extrapolation function to minimize systematic errors is tabulated in an appendix, and its application to the measurement of precision lattice parameters is demonstrated using the I.U.Cr. specimens of silicon and tungsten. — *from* Authors' abstract

Kirkland, D. W. *See* Davis, J. B. 04309

Kisiel, Chester C. *See* Moench, Allen F. 03985

03954 **Klein, David H.; Goldberg, Edward D.** Mercury in the marine environment: Environmental Sci. and Technology, v. 4, no. 9, p. 765-768, illus., 1970.

Intentional or uncontrolled discharge of 4,000-5,000 tons of mercury per year from mining operations and industrial consumers, which ultimately settles in the marine environment, may be compared with 5,000 tons transferred by rivers following continental weathering. Mercury levels in coastal marine organisms from off La Jolla and Palos Verdes, Calif., are 500 times greater than in comparable volumes of sea water. Man's influence is implied by higher values found in sediments near Los Angeles sewer outfalls, fifty-fold those in similar deposits further removed. Evidence associating mercury dispersion with volcanism and hydrothermal transport is less convincing; rather, the high mercury content in sediments on the east Pacific Ridge may be explained by high organic activity. Pollution studies involving mercury may benefit from the identification of indicator organisms in diagnosing man's impact upon his environment. — GDC

Kleinhampl, F. J. *See* Rogers, C. L. 04246

Kleinhampl, Frank J. *See* Albers, John P. 04240

04211 **Klesse, Elmar.** Geology of the El Ocotito-Ixcuinatoyac region and of La Dicha stratiform sulphide deposit, State of Guerrero: Soc. Geol. Mexicana Bol. 1968, v. 31, no. 2, p. 107-140, illus., tables, geol. map, 1970.

The area around Ixcuinatoyac in the Sierra Madre del Sur, central Guerrero, once reached maturity and later was rejuvenated. The oldest Precambrian or Paleozoic clastic sediments are overlain by Triassic-Jurassic volcanic and sedimentary rocks, followed by Lower Cretaceous limestones and dolomites, with two generations of intrusives, an Upper Cretaceous granite stock and middle Tertiary diorites and gabbros. Late Cretaceous processes determined the structure of the region. The strike of the earliest foliation was developed by a Precambrian or Paleozoic orogeny, and that of later foliation and fold axes was aligned around the granite intrusive. Present foliation and fold patterns resulted from the granite emplacement and from the early Tertiary Hidalgo Orogeny. A barite deposit and sulfide deposit are described. — *from* Author's abstract

Kline, D. *See* Chaterlain, A. 04402

03964 **Knopoff, L.; Randall, M. J.** The compensated linear-vector dipole — A possible mechanism for deep earthquakes: Jour. Geophys. Research, v. 75, no. 26, p. 4957-4963, 1970.

Models of earthquake sources that have no volume change, no net force, and no net torque as criteria for the radiation of first motions, have five degrees of freedom in their spatial orientation. The usual double-couple model has only three degrees of freedom. The most general source of high-frequency seismic motions must be a linear combination of a double couple and another source called the compensated linear-vector dipole. A radiation pattern of amplitudes of first motions on the focal sphere cannot be uniquely decomposed into the radiation patterns due to the two sources. — Authors' abstract

Knopoff, L. *See* Randall, M. J. 03965

04342 **Knutilla, R. L.** Water resources of the Black River basin, southeastern Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA-338, 3 sheets, scale 1:125,000, text, 1970.

Sheet 1 contains information on physical setting and surface water resources of the Black River basin, sheet 2 on quality of water, and sheet 3 on geology and ground water. Ground water is generally softer than surface water and usually requires less treatment for domestic use. Some water can be obtained almost anywhere from wells completed in glacial deposits or in bedrock; in glacial drift well yields range from 1-100 gpm, in bedrock to 500 gpm. — MCM

03808 **Koch, George S., Jr.; Link, Richard F.** Statistical analysis of geological data: New York and London, John Wiley and Sons, 375 p., illus., tables, 1970.

Koch, Nell C. *See* Hedges, Lynn S. 04003

04078 **Koesoemadinata, R. P.** Stratigraphy and petroleum occurrence, Green River Formation, Red Wash field, Utah, Pt. A: Colorado School Mines Quart., v. 65, no. 1, 77 p., illus., tables, geol. map, 1970.

The shore phases of the lacustrine lower part of the Eocene Green River Formation in the Red Wash-Raven Ridge area is investigated. The Green River Formation overlies and sometimes interfingers the Wasatch Formation and is overlain by the Uinta Formation. Five subdivisions of the Green River are recognized as stratigraphic units; sandstone facies in the lower part are divided into smaller units. Isopach and isolith maps, stratigraphic diagrams, sedimentary structure sequences, and electric-log sections accompany the report, and depositional history is summarized from the isolith maps. The Red Wash oil field is one of the largest producers from non-marine sediments in the world. The reservoir, entrapment of petroleum, characteristics of the crude, and production and reserves are discussed. — ESL

Kolehmainen, Victoria. *See* Craddock, Campbell. 04382

Kolopus, J. L. *See* Chaterlain, A. 04402

04225 **Komornik, Amos; David, David.** Prediction of swelling pressure of clays — Closure [to discussion of paper 6358, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1792, 1970.

Paper 6358 (ibid., v. 95, no. SM1, p. 209-225, 1969) was cited in Abs. North American Geology, June 1969, and discussion by M. Livneh (ibid., v. 96, no. SM1, p. 323-324, 1970) in June 1970.

Kopp, Otto C. *See* Potosky, Robert A. 04040

04044 **Kopp, Otto C.** Ferrisilicates, counterparts of the common aluminosilicates, and the dual role of Fe^{+3}: Compass, v. 47, no. 2, p. 119-124, table, 1970.

Because of its size, the Fe^{+3} ion is often assumed to occupy octahedrally coordinated sites in silicate minerals. Recent experimental studies suggest that significant amounts of Fe^{+3} may also replace silicon in tetrahedral sites, producing silicates, which by analogy to the aluminosilicates might be called "ferrisilicates." Mineralogists and other interested workers need to recognize and accept the dual role of ferric iron in silicate mineralogy and to make a unified effort to determine the nature and extent of isomorphous substitution within both natural and synthetic aluminosilicates and ferrisilicates. — Author's abstract

03789 **Kornfeld, Joseph A.** Deep oil being sought in southeastern U.S.: World Oil, v. 171, no. 4, p. 80-82, illus., 1970.

A major Jurassic oil discovery in northwestern Florida has increased leasing activity and deep drilling. Some 460 miles to the southeast, two deep oil strikes in Lee and Hendry Counties have stimulated 11,000-12,000-foot drilling for Cretaceous Sunniland carbonate oil reservoirs. — Author's abstract

04150 **Kornfeld, Joseph A.** Economics and geology of the natural gas of North America [abs.]: Houston Geol. Soc. Bull., v. 13, no. 1, p. 4, 1970.

04025 **Korver, John A.** T-WAVE, a computer code for analyzing the nonsteady gravity decay of a groundwater anomaly — UCRL-50830: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., 58 p., illus., 1970.

The T-WAVE Code is based on a one-dimensional numerical model describing the gravity decay of a groundwater mound. The Fortran program for the T-WAVE Code may be used to examine the time-dependent flow characteristics of anomalous ground-water mounds resulting from underground nuclear explosions near or below the regional water table. The code allows the permeability and/or porosity to be in either a cylindrical or spherical geometry surrounding the shot point, and it also allows for internal horizontal or vertical discontinuities of the permeability or porosity. It is also possible to follow the horizontal displacement of ideally tagged water particles as a function of time. — Author's abstract

04326 **Kottlowski, Frank E.; Stewart, Wendell J.** The Wolcampian Joyita uplift in central New Mexico: New Mexico Bur. Mines and Mineral Resources Mem. 23, p. 1-31, illus., 1970.

Joyita Hills is a complex horst east of the Rio Grande graben in Socorro County; there has been postulated a nearby uplift during late Desmoinesian, Missourian, and Virgilian time. The upper Pennsylvanian limestones bear Missourian fusulinids. Bursum-facies arkosic limestone-conglomerates, early Wolfcampian, derived on the south from Pennsylvanian limestones and Precambrian granite gneiss, truncate southwestward Missourian, Desmoinesian, Atokan, and Precambrian rocks, to abut remnant hills of the gneiss buried, in southern Joyita Hills, by Abo red beds which gradually overlie Bursum shales and limestones. In Atokan-Desmoinesian time Joyita Hills area was a submarine platform with small low islands; thinness of remnant upper Pennsylvanian strata is due to erosion in early Wolfcampian time. As the Bursum facies is unconformably on Virgilian beds in many parts of central New Mexico, the Joyita uplift documents the later episode of erosion and clastic deposition. — *from* Authors' abstract

Kramer, Fritz L. *See* Patton, Clyde P. 04126

04101 **Krusiewski, S. Victoria.** Selected bibliography on radioactive occurrences in the United States — RME-4110: Washington, D.C., U.S. Atomic Energy Comm., 136 p., 1970.

This compilation lists only the longer and most useful publications on radioactive occurrences in the United States that have been issued in the period from 1950 through early 1970; a few items published prior to 1950 have been included. Information on securing some of the publications is given and a sketch map shows important uranium districts. — MCM

Kuo, Chin-Shin. *See* Haach, U. 04285

03906 **Kuroda, P. K.; Manuel, O. K.** Mass fractionation and isotope anomalies in neon and xenon: Nature, v. 227, no. 5263, p. 1113-1116, illus., 1970.

The neon and xenon isotope anomalies observed in meteorites can be interpreted in terms of a mass fractionation, which is common for both elements. It is not necessary to assume the existence of large excesses of fission-type xenon in carbonaceous and gas-rich chondrites. — Authors' abstract

Kuroda, P. K. *See* Manuel, O. K. 04273

04092 **Kvenvolden, Keith A.** Evidence for transformations of normal fatty acids in sediments, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 335-366, illus., tables, 1970.

Geochemical evidence for fatty acid transformations in sediments has been obtained from study of six modern unconsolidated basin, delta, bay, and lake sediments and eleven ancient rocks including shales and limestones of Devonian to Pliocene age. In modern sediments, normal fatty acids are remarkably similar indicating that chemical and geochemical degradations during sedimentation produce similar mixtures of the acids. Normal fatty acid C-16 is most abundant, and next are even-carbon-numbered fatty acids in the range C-24 to C-31. In ancient sediments, normal fatty acids have distributions from those similar to modern sediments to those in which even- and odd-carbon-numbered are equally abundant; the older the rock, the more likely a smooth distribution. However, favorability of environment for chemical transformation is more important than time in determining distribution. — VSN

03830 **Kwak, Teunis A. P.** An attempt to correlate non-predicted variations of distribution coefficients with mineral grain internal inhomogeneity using a field example studied near Sudbury, Ontario: Contr. Mineralogy and Petrology, v. 26, no. 3, p. 199-224, illus., tables, 1970.

It is suggested that the irregularity of the distribution coefficients [of elements] is due to chemical variations of the bulk chemistry of metamorphic minerals, both from handspecimen to handspecimen and in different parts of a single handspecimen. Samples from the staurolite-quartz, kyanite-muscovite, and sillimanite-K feldspar subfacies from near Sudbury were submitted to mineral separation and analysis as well as electron microprobe analysis. Despite the fact that much scatter occurs between distribution coefficients due to partial re-equilibration, the values of Mg and Fe^{+2} of biotite/garnet distribution decrease and Mn and Ca increase recognizably across the area. Generally, the models proposed seem applicable to the field data presented. — *from* Author's abstract

Lachance, G. R. *See* Wanless, R. K. 04096

03958 **Ladanyi, B.** The pore pressure-strain relationship of normally consolidated undisturbed clays — Pt. 1, Theoretical consideration — Discussion [of paper by K. Y. Lo, 1969]: Canadian Geotech. Jour., v. 7, no. 3, p. 341-342, illus., 1970.

The original paper was published ibid., v. 6, no. 4, p. 383-394, 1969; *see* Abs. North American Geology, June 1970. Ladanyi questions the validity of two statements: one concerning the separation of principal stress in a pore pressure equation, and the other "stress theories" of pore pressure. — GDC

Ladanyi, B. *See* Hoyaux, B. 03961

Lahr, John C. *See* Sbar, Marc L. 04431

Lakin, Hubert W. *See* Curtin, Gary C. 04255

Lamb, James L. *See* Robinson, E. 04065

03980 **Landisman, M.; Usami, T.; Sato, Y.; Massé, R.** Contributions of theoretical seismograms to the study of modes, rays, and the Earth: Rev. Geophysics and Space Physics, v. 8, no. 3, p. 533-589, illus., 1970.

Theoretical seismograms, for simplified and realistic Earth models, can be calculated and analyzed for relations between free oscillations and traveling waves. Principal results include equivalence of mantle and crustal Rayleigh waves to fundamental radial modes of spheroidal free oscillations; equivalence of G waves and ordinary Love waves to fundamental radial modes producing all direct, reflected, refracted, and diffracted body phases, and higher-mode surface waves. Stoneley-wave propagation along core-mantle boundary introduces interesting phenomena into propagation of spheroidal overtones. Confinement of Stoneley modes to the boundary vicinity is responsible for discontinuities in spectra and relative difficulty in excitation of long-period P and SV diffracted arrivals, as compared with corresponding SH phases. Trapping of body-wave energy for sources within a velocity inversion is demonstrated. Surface particle motion ratio may be as useful as phase velocity in understanding physical properties beneath a recording site; realistic curves of this parameter are presented. — *from Authors' abstract*

Lane, H. Richard. *See* Straka, Joseph J., 2d. 04372

03909 **Lane, N. Gary.** On the crinoid order Declinida Knapp, 1969 [discussion of "Declinida, a new order of late Paleozoic inadunate crinoids" by W. D. Knapp, 1969]: Systematic Zoology, v. 19, no. 3, p. 308-310, 1970.

Reasons are outlined for rejection of Knapp's hypothesis (Jour. Paleontology, v. 43, no. 2, p. 340-391, 1969; Abs. North American Geology, January 1970) to support establishment of the new Order Declinida; these crinoids should remain in Order Cladida. — VSN

04209 **Lane, N. Gary.** Lower and Middle Ordovician crinoids from west-central Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 1, p. 3-17, illus., 1970.

Ten specimens of inadunate crinoids are described from the Canadian to Chazyan Pogonip Group in Millard County, Utah. The mostly fragmentary specimens are treated as nine species. The oldest, from the Fillmore Limestone, are *Hybocrinus* sp. A and incertae sedis spp. B and D; incertae sedis sp. C was found in the overlying Wahwah Limestone (late Canadian). The most complete specimens are the heterocrinid *Atopocrinus priscus*, n.gen., n.sp., and the homocrinid *Ibexocrinus lepton*, n.gen., n.sp., from the Kanosh Shale (Whiterock Stage), which also yielded ?*Hoplocrinus* sp. A, similar to a Middle Ordovician species from Estonia, and *Cupulocrinus* sp. A. The Chazyan Lehman Formation yielded incertae sedis sp. A. Crinoids of comparable ages in the eastern U.S. are almost all camerates. — VMJ

Langseth, Marcus G., Jr. *See* Epp, David. 04272

Langway, C. C. *See* Johnson, S. J. 04072

04148 **Larach, Simon; Shrader, Ross E.; Kauffunger, Richard A.** Cathode-ray-excited emission spectroscopic analysis of trace rare earths — Pt. 4, Determination of thuli-

um in zinc sulfide [with French and German abs.]: Anal. Chim. Acta, v. 51, no. 3, p. 393-398, illus., tables, 1970.

The method of analysis for trace amounts of rare earths in a matrix by cathode-ray-excited emission spectroscopy has been extended to the determination of thulium in a zinc sulfide matrix, with lithium added as a charge-compensating ion. If the 478-nm emission from thulium is used as the detection wavelength, one ppb can be readily determined, with an estimated detection limit of the order of 0.01 ppb. Thulium determinations by this means are compared with those from solid-state mass spectrometry. Effects of sample firing parameters and interferences are discussed. — Authors' abstract

Latham, Gary V. *See* Warren, Nicholas W. 04444

04117 **Latour, B. A.; Chrismas, L. P.** Preliminary estimate of measured coal resources including reassessment of indicated and inferred resources in western Canada: Canada Geol. Survey Paper 70-58, 14 p., illus., tables, 1970.

Measured coal resources in the ground in western Canada as of January 1, 1970, are estimated to total 9.8 billion tons, comprising 8.3 percent of resources of all categories (measured, indicated and inferred) which are estimated to total 118.7 billion tons. The bulk of measured resources of low and medium volatile bituminous coal, which reflects potential coking-coal resources, are located in southeastern British Columbia. Considering the vast amount of unexplored land in the mountain belt of Alberta, it is likely that resources of this area will be increased substantially. Only seven percent of measured resources of bituminous coal can be mined by surface methods, whereas measured lignite resources of Saskatchewan and subbituminous resources of Alberta could be surface-mined. — *from* Author's abstract

Lavin, Peter M. *See* Rankin, William E. 04057

04407 **Lawlor, Florine.** Exploring Nevada's Gypsum Cavern: Desert, v. 33, no. 1, p. 28-29, 38, illus., 1970.

Gypsum Cavern lying in the limestone spur of Frenchman Mtn. offered shelter for Pleistocene man and a ground sloth, whose remains were found crushed by a rock fall, perhaps due to an earthquake, by members of an archeological expedition to the area in 1925. The cave is divided into five rooms measuring a total length of 300 feet. In Room One, a layer of refuse 20 inches deep indicates how long man lived here. Many artifacts were found in all the rooms as well as remains of a camel, tortoise, condor, a baby sloth, and many sloth claws. The cave was formed during a very wet period connected with advance of Pleistocene glaciers, followed by increasing dryness. This would indicate the lowest level culture in the cave to be 10,500 yr B.P. — ESL

03786 **Lawrence, Robert D.** Stress analysis based on albite twinning of plagioclase feldspars: Geol. Soc. America Bull., v. 81, no. 8, p. 2507-2512, illus., 1970.

Plagioclase twins mechanically on the albite law. Twinning is most likely to occur when the resolved shear stress on the twin plane (010), and in the glide direction, perpendicular to [100] in (010), is at a maximum. Only those crystals oriented in the stress field to approximately meet this condition will twin. Thus, in a rock containing mechanically twinned grains, the principal stress directions affecting the rock may be approximated by measuring the twin elements of these grains. The plagioclase fabric must be taken into account if the results are to be significant. Study of samples of anatectic granodiorite of the Chewack River Gneiss in the northeastern Cascade Range, Washington, where the unit was deformed adjacent to the Chewack-Paysaten fault, demonstrate the use of the method. — Author's abstract

LeCampion, Thérèse. *See* Golubic, Stjepko. 03872

Lee, John J. *See* McEnery, Marie. 04058

Lee, W. H. K. *See* Eaton, J. P. 03975

04002 **Leisman, Gilbert A.** A petrified *Sporangiostrobus* and its spores from the Middle Pennsylvanian of Kansas: Palaeontographica, Abt. B., v. 129, nos. 4-6, illus., 1970.

Sporangiostrobus kansasensis sp. nov., is bisporangiate, with the sporangia aligned spirally, vertically, and horizontally. Only the primary xylem is preserved in the cone axis, and it is in the form of an exarch siphonostele. The sporangia are attached to the adaxial side of the sporophyll pedicel; there is evidence of a distal ligule. The microspores are of the densospore type and are extremely variable. The megaspores are of the *Zonalesporites* type and vary in proximal and distal ornamentation. Associated vegetative remains, believed to belong to the parent plant, are a leaf, described as *Lepidophylloides calcaratum* sp.nov., and a stem, as *Lepidodendron dacrydioides*, sp.nov. — *from* Author's abstract

04389 **Leisman, Gilbert A.; Peters, John S.** A new pteridosperm male fructification from the Middle Pennsylvanian of Illinois: Am. Jour. Botany, v. 57, no. 7, p. 867-873, illus., 1970.

Rhetinotheca tetrasolenata gen. et sp.n. is described from a Herrin No. 6 coal ball from Illinois. It consists of an ellipsoidal cluster of small synangia bearing spores of the *Monoletes* type. Although the synangia are partially connected to each other by sparse sterile tissue, evidence indicates that the synangia are immature, and it is presumed that they separated and spread apart at maturity. A small portion of the protostelic axis is present near the center of the cluster. Individual synangia consistently contain four sporangial tubes and measure 2.0-3.6 mm long by 0.7-1.2 mm in diameter. A conspicuous central columella is present. When compared with compression forms, *Rhetinotheca tetrasolenata* compares most favorably with *Aulacotheca iowensis*. — *from* Authors' abstract

Leland, George R. *See* Ericksen, George E. 03818

Lemish, J. *See* Simon, D. E. 04451

04448 **Leung, Irene Sheung-Ying.** An optical and X-ray analysis of deformation structures in diopside [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 10, p. 4664B, 1970.

03880 **Leve, G. W.** Report on geophysical and television exploration in City of Jacksonville water wells: Florida Bur. Geology Inf. Circ. 64, 15 p., illus., table, 1970.

Geophysical and television exploration in eight Jacksonville water production wells were conducted to appraise water resources. Methods used were electrical, gamma, and caliper logging, and current-meter and television traverses. Electrical and gamma logs show relatively hard beds of rock present in the aquifer between about 700 and 950 feet below surface; relatively soft porous rock is present above and below these beds, although there are thin beds of hard rock below about 950 feet. Most water enters wells from soft porous zones between 500 to 700 feet or between 950-1,200 feet. Data from each of the wells is analyzed. — MCM

04371 **Levinton, Jeffrey S.** The paleoecological significance of opportunistic species: Lethaia, v. 3, no. 1, p. 69-78, illus., tables, 1970.

Opportunistic species are not resource-limited; with favorable events they can increase rapidly in numbers. Such species populations are typically very unstable and may become extinct very quickly. In contrast, equilibrium species populations are resource-limited and maintain stable population levels. Identification of explosive opportunistic species in the fossil record is an important means of recognizing animal communities that were primarily controlled by the physical, not the biotic, environment. In young environments of high physiological stress most species are opportunistic. In old and biologically accommodated communities opportunists are relatively rare. Explosive opportunists can be recognized in fossil faunas by use of distributional and facies relations, and relative abundance data. — *from* Author's abstract

04108 **Lewellen, Robert; Brown, Jerry.** Man induced erosion on permafrost [abs.], *in* Alaska Sci. Conf., 20th, College, 1969, Proc.: Sci. Alaska 1969, p. 333-334, 1970.

Lewontin, Richard C. *See* Selander, Robert K. 03871

04184 **Lilienberg, D. A.** Osobennosti geomorfologii Kuby [Features of the geomorphology of Cuba]: Moskov. Obshch. Ispytateley Prirody Byull., Otdel Geol., v. 45, no. 1, p. 155-156, 1970.

The geomorphological features of Cuba are discussed, giving examples from various parts of the island. Mountains are classified as: (1) very old, arch-block, erosional tectonic; (2) younger, block, erosional-tectonic; (3) younger, petromorphic; (4) young, elevated, block-monocline, erosional-tectonic. Highlands are classified as erosional, petromorphic, and structural. Plains are typed as maritime, deltaic, fluvial, lacustrine or denudational. Intense weathering, chemical-erosion processes, and karst-forming processes are prevalent. — EH

04439 **Lincoln, J. B.; Miller, R. J.; Tettenhorst, R.** Random powder mounts from montmorillonite aerogels: Clay Minerals, v. 8, no. 3, p. 347-348, illus., 1970.

Another method of obtaining randomly oriented particles of montmorillonite, involving the formation of an aerogel upon freeze-drying the clay suspension, is presented. The suspension was sprayed into ultra-cold pentane and froze on contact; it was then placed in the freeze-dry apparatus for several days. The fluffy aerogel was then back loaded into a sample holder for X-ray diffractomery. — ESL

03917 **Lineback, J. A.; Ayer, N. J.; Gross, D. L.** Studies of Lake Michigan bottom sediments — No. 3, Stratigraphy of unconsolidated sediments in the southern part of Lake Michigan: Illinois Geol. Survey Environmental Geology Note 35, 35 p., illus., 1970.

Unconsolidated sediments of late Pleistocene age in southern Lake Michigan can be divided into two major lithologic units: upper, dominantly lacustrine clay, soft and variably fossiliferous, is assigned to the Lake Michigan Formation which is divided into six members and one bed; and lower, compact sandy sediments of glacial origin, more compact, coarser grained and containing less water than the Lake Michigan Formation, are assigned to the Carmi Member of the Equality Formation and overlie glacial tills that are assigned to the Wadsworth Member of the Wedron Formation. — *from* Authors' abstract

04391 **Ling, Hsin-Yi.** Silicoflagellates from central North Pacific core sediments: Bulls. Am. Paleontology, v. 58, no. 259, p. 85-129, illus., 1970.

Silicoflagellates are siliceous planktonic microorganisms which have never been a significant constituent of pelagic sediments. Their importance as guide fossils has been recognized only during the last few decades. From the central North Pacific deep-sea sediments collected during the 28th cruise of RV *Thomas G. Thompson*, 11 silicoflagellate taxa with one new species, *Dictyocha subarctios*, were recovered. The lower lithological unit of TT28-25 core is identified as Miocene after a comparison of the faunal composition with the known Tertiary land records. Quaternary occurrences of *Mesocena* cf. *elliptica* are discussed, and its most recent extinction together with the latest appearance of *Dictyocha* cf. *ausonia* and *D. subarctios* may suggest a biostratigraphic datum for the middle latitude of the north Pacific deep-sea sediments. — Author's abstract

Link, Richard F. *See* Koch, George S., Jr. 03808

03777 **Lipman, Peter W.; Steven, Thomas A.; Mehnert, Harald H.** Volcanic history of the San Juan Mountains, Colorado, as indicated by potassium-argon dating: Geol. Soc. America Bull., v. 81, no. 8, p. 2329-2351, illus., tables, 1970.

In the San Juan volcanic field, alkali andesite, rhyodacite, and mafic quartz latite were erupted mostly 35 to 30 m.y. ago. Explosive ash-flow eruptions of quartz latite and low-silica rhyolite occurred 30 to 26 m.y. ago. Minor basalts and rhyolites were erupted about 23 to 5 m.y. ago. The marked compositional contrast between the older and younger volcanic rocks implies either different conditions of magma generation or processes of differentiation for the two suites. — RWK

04242 **Lipman, Peter W.; Steven, Thomas A.** Reconnaissance geology and economic significance of the Platoro caldera, southeastern San Juan Mountains, Colorado, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C19-C29, illus., 1970.

The Platoro caldera is a composite collapse structure that formed as a result of ash-flow eruption of the upper Oligocene Treasure Mountain Tuff. Three major ash-flow sheets of tuff are approximately coextensive and cover about 5,000 km² in the southeastern San Juan Mountains. Major collapse of the Platoro caldera occurred during eruption of quartz latitic ash flows that form the La Jara Canyon Member; late ash flows of this member accumulated within the collapsing caldera to a thickness of more than 800 m. Genetically related quartz latitic dikes and granitic stocks, with associated lavas, were emplaced repeatedly around margins of the late caldera, and associated hydrothermal alteration and local ore deposition took place in mineralized areas. These mineralized areas, which had previously appeared anomalous, are therefore comparable to other caldera-associated mineralization in the central and western San Juan Mountains. — *from* Authors' abstract

Liu, Lin-gun. *See* Takahashi, Taro. 04277

Lockwood, John P. *See* Bateman, Paul C. 04014

04392 **Londe, Pierre; Vigier, Gaston; Vormeringer, Raymond.** Stability of rock slopes, a three dimensional study — Closure [to discussion of paper 6363, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1792-1793, 1970.

Paper 6363 (ibid., v. 95, no. SM1, p. 235-262, 1969) was cited in Abs. North American Geology, June 1969, and L. S. Srivastava's discussion (ibid., v. 96, no. SM1, p. 327-329), in June 1970.

03902 **Loomis, Stuart R.** Morphology and ablation processes on glacier ice: Assoc. Am. Geographers Proc., v. 2, p. 88-92, illus., 1970.

Differential ablation on debris-laden glacier ice has long been recognized for its importance in producing ice-cored topographical features. A study of ablation rates on a medial moraine of the Kaskawulsh Glacier, Yukon, is used in conjunction with ice flow data and an equilibrium hypothesis of mass movement in the debris mantle to explain the morphological form that the moraine assumes. — Author's abstract

Lorenz, Douglas M. *See* Bretsky, Peter W. 03779

Loveridge, William D. *See* Wanless, Robert K. 03926

Low, Doris. *See* Todd, Ruth. 03904

04280 **Lowell, J. David; Guilbert, John M.** Lateral and vertical alteration-mineralization zoning in porphyry ore deposits: Econ. Geology, v. 65, no. 4, p. 373-408, illus., tables, 1970.

The San Manuel-Kalamazoo deposit, Pinal County, Ariz., is described as typical of porphyry copper and molybdenum deposits. A table of geologic characteristics of 27 major porphyry deposits is presented to show that the typical deposit is in Late Cretaceous sediments and metasediments, associated with a Laramide quartz monzonite stock. The host intrusive rock is elongate-irregular, 4,000× 6,000 feet in outcrop, and progressively differentiated from quartz diorite to quartz monzonite, is more like a stock than a dike, and is controlled by regional-scale faulting. The orebody is oval to pipelike, with dimensions of 3,000 × 6,000 feet and gradational boundaries. Seventy percent of the ore occurs in the igneous host rocks. Metal values, zoned alteration, and mineral assemblages are characteristic. The vertical and lateral zoning is sufficiently repetitive with depth of exposure that many deposits can be directly compared with the San Manuel-Kalamazoo model. — VSN

04128 **Lublin, P.; Cukor, P.; Jaworowski, R. J.** Mass absorption coefficient measurements using thin films, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 632-638, tables, 1970.

For quantitative electron probe analysis, raw intensity ratios must be corrected to take into account deviations due to absorption, fluorescence, and electron beam penetration. The major correction is usually absorption, so accurate mass absorption coefficients are required. The region which requires most attention for present-day probe analysis is the 2 to 10A range. Thin foils of the lighter metals are available, but heavy-metal foils, which must be extremely thin, are not. A method has been developed to prepare thin films of heavy metals on a substrate by pyrolitic decomposition of metal organic compounds. The films have proved satisfactory for measurements in respect to density and continuity, for aluminum, nickel, tungsten, and gold. Good agreement in comparison with other measurements was obtained. — *from* Authors' abstract

03790 **Lucon, C.; Feugere, G.; Gerard, R. E.** Geochemical exploration method accurate in field test: World Oil, v. 171, no. 4, p. 74-75, illus., 1970.

Information from a geochemical survey indicated poor production possibilities on what was considered to be an excellent Canadian seismic prospect. A wildcat drilled later on the structure was dry, indicating the geochemical prediction was correct. — Authors' abstract

03940 **Lumb, Peter.** Safety factors and the probability distribution of soil strength [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 225-242, illus., tables, 1970.

For soils exhibiting both cohesive and frictional components of strength, the natural variabilities of the components are compared for soil in the undisturbed state and as compacted in earth dams. The probability distributions of the components are shown to agree more closely with a theoretical beta distribution than with the commonly assumed normal distribution. The cohesive and frictional components can be regarded as independent variables and the design safety factor interpreted in terms of probabilities. Assuming equal probabilities for each component leads to the use of partial safety factors which are larger for the cohesive than for the frictional part. For long-term stability problems limiting partial safety factors corresponding to zero probability can be obtained. The undrained strength of clays also agrees with a beta distribution, but in this case there are no limiting safety factors, and some non-zero probability must be associated with the design. — Author's abstract

Luthin, James N. *See* Ortiz, Jaime. 04385

03825 **Luyendyk, Bruce P.** Origin and history of abyssal hills in the northeast Pacific Ocean: Geol. Soc. America Bull., v. 81, no. 8, p. 2237-2260, illus., 1970.

Two abyssal hills of different origin were investigated using a near-bottom geophysical instrument package. Both hills are approximately 40 by 10 km and several hundred meters of relief. The western hill is an elongate shield volcano and was formed about 30 m.y. ago at the crest of the East Pacific Rise. The eastern hill is a block fault (horst) structure apparently formed during several episodes of faulting which were initiated after accumulation of tens of meters of pelagic sediments. Because of a closely spaced, two-dimensional structural grain of weakness that is frozen in the oceanic crust at a rise crest, both the younger and older topography have the same strike. — HCW

04019 **Lynn, Warren C.; Grossman, Robert B.** Observations of certain soil fabrics with the scanning electron microscope: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 645-648, illus., 1970.

The scanning electron microscope permits examination of soil fabrics over a magnification range of 50 to 30,000 diameters. The relatively large depth of focus makes possible study of rough surfaces. This paper discusses mounting procedures and shows photographs of fabrics of spodic and fragipan horizons, of the B horizon of a

clayey Tropohumult, and of two ped-surface features, well expressed skeletans and argillans. — Soil brief

04034 **MacCarthy, Ronald F.** The Campbell strandline of Glacial Lake Agassiz in Walsh County, North Dakota: Compass, v. 47, no. 3, p. 147-153, illus., table, 1970.

The Campbell escarpment is one of the most important shore features of Glacial Lake Agassiz, the largest of the late Wisconsinan lakes in North America. Investigation of the escarpment shows that it was formed during a rise in the lake level instead of a long period of lake level stability as has been assumed in the past. Upham's (1895) McCauleyville "beach" is closely related to the Campbell scarp and was probably an offshore deposit developed during the final phase of scarp development. The conditions under which the escarpment was formed have suggested a possible avenue for climatic research. — Author's abstract

03971 **Maher, Stuart W.** Possible basement control of geologic phenomena in Tennessee [abs.]: Tennessee Acad. Sci. Jour., v. 45, no. 2, p. 53, 1970.

03981 **Maher, Stuart W.; Fagan, James M.** Trace element content of some ore deposits in the Southeastern States: Tennessee Div. Geology Inf. Circ. 16, map with text and table, 1970.

The principle source of data is a World War II mine, mill, and smelter study and a number of trace-element determinations made by the Atomic Energy Commission. Results of these analyses are presented in a table, by states, and sample localities are shown on a map. Mercury analyses were made by wet chemical methods; other elements, except zinc, were analyzed by spectrochemical procedures. Samples from each state are arranged in stratigraphic order, according to the age of host rocks. It is noteworthy that the absence of precious metals in sphalerite is characteristic of Mississippi-Valley type deposits; the presence of beryllium in nine samples of sphalerite is unusual, but this report shows that it is not rare in the Southeast. States covered are Kentucky, Tennessee, Virginia, and North Carolina. — ESL

Malkus, W. V. R. *See* Howard, L. N. 04120

Maloney, W. E. *See* Andersen, N. R. 03996

Mangum, John H. *See* Reed, John C., Jr. 04258

04375 **Manheim, F. T.; Sayles, F. L.** Brines and interstitial brackish water in drill cores from the deep Gulf of Mexico: Science, v. 170, no. 3953, p. 57-61, illus., table, 1970.

Marked increases in interstitial salinity occur in two drill holes located in the Gulf of Mexico at a water depth of more than 3500 m. The increases probably arose through diffusion of salt water from buried evaporites. In one hole, however, brackish water was encountered on penetrating the oil-permeated cap rock of a salt dome. The phenomenon is attributed to production of fresh water during oxidation of petroleum hydrocarbons and decomposition of gypsum to form native sulfur. — Authors' abstract

03973 **Manlatis, Jessie Klyce.** Carbonate petrography of Middle and Upper Ordovician rocks in the Central Basin of Tennessee [abs.]: Tennessee Acad. Sci. Jour., v. 45, no. 2, p. 53-54, 1970.

03912 **Mann, J. A.; Cherry, R. N.** Large springs of Florida's "Sun Coast," Citrus and Hernando Counties: Florida Bur. Geology Leaflet 9, [22] p., illus., table, 1970.

Florida has about 20 first magnitude springs (at least 64.6 mgd), more than any other state. Four of these large spring complexes provide almost the entire fresh-water flow of Crystal, Homosassa, Chassahowitzka, and Weekiwachee Rivers, with a combined flow of about one billion gallons a day; the spring complex at the head of Crystal River is the largest. The flow of all the springs varies seasonally, and tidal fluctuations also affect it. Much of the 55 inches of rain per year enters the Floridan aquifer and

flows westward toward the springs, some of which discharge salty water, some fresh, and some alternate. In theory, in a coastal aquifer each foot of fresh water above sea level would indicate 40 feet of fresh water below sea level. Hydrologic investigations in the area are continuing. — ESL

Manuel, O. K. *See* Kuroda, P. K. 03906

04273 **Manuel, O. K.; Wright, R. J.; Miller, D. K.; Kuroda, P. K.** Heavy noble gases in Leoville — The case for mass fractionated xenon in carbonaceous chondrites: Jour. Geophys. Research, v. 75, no. 29, p. 5693-5701, illus., tables, 1970.

The isotopic composition of krypton and xenon in the Leoville carbonaceous chondrite is reported for both total melt and stepwise heating experiments. The enrichment of heavy xenon isotopes in the low-temperature fractions is paralleled by an enrichment of heavy krypton isotopes. Evidence is presented in support of simple mass fractionation as the mechanism responsible for excess heavy xenon isotopes in carbonaceous chondrites. — Authors' abstract

03785 **Marchand, Denis E.** Soil contamination in the White Mountains, eastern California: Geol. Soc. America Bull., v. 81, no. 8, p. 2497-2505, illus., tables, 1970.

Mineralogical investigation of lithosols formed on dolomite in a semiarid, subalpine environment reveals up to 30 percent contamination of the very fine sand fraction by rhyolitic ash from a distant source and as much as 50 percent local contamination of the silt fraction, largely attributable to aeolian processes. Total extraneous particles range from 3 to 73 percent in sand or silt fractions of a given soil sample. Short term dust-trap and snow-residue collections place minimum aeolian deposition at approximately 0.00014 grams per sq. cm^{-1} yr^{-1}, a rate sufficient to account for the amounts of observed contamination. The data emphasize the need for precaution in interpretation of soil mineralogy and chemistry, under many climatic and topographic influences and in areas subject to Pleistocene volcanism. — Author's abstract

03987 **Martin, C. S.** Effect of a porous sand bed on incipient sediment motion: Water Resources Research, v. 6, no. 4, p. 1162-1174, illus., tables, 1970.

Incipient motion tests were conducted for flow into and out of a porous bed. Seepage out of a bed does not affect incipient motion measurably because the seepage force is lost once a sediment particle rocks. Seepage into a bed may either enhance or hinder incipient motion, depending upon the relative effect of the boundary shear stress and the seepage force, both of which depend on the seepage flow. For a given hydraulic gradient the size of the sand grains is critical regarding incipient motion. For turbid water flow over a bed, fine particles of the mixture may become deposited in the bed, resulting in a concrete-like more resistant bed. Typical values of the hydraulic gradient are given for flow out of a canal and in an ocean bed under oscillatory waves. — Author's abstract

Martin, D. F. *See* Allen, R. J. 04421

03802 **Martin, Dean F.** Marine chemistry (in two volumes) — V. 2, Theory and applications: New York, Marcel Dekker, 451 p., illus., tables, 1970.

This volume, developed as a result of an introductory course in marine chemistry at advanced undergraduate and graduate level, is intended primarily for those without an extensive background in chemistry but with a more intensive background in other fields. Chapter headings are: physical and chemical properties of sea water, mixing processes in the marine environment, energy flow in the marine exosystem, model ocean, silicon cycle, phosphorus cycle, nitrogen cycle, carbon cycles, organic productivity, resources of the sea, and food from the sea. A list of plankton terminology, and author and subject indexes are appended. — MCM

Marvin, Richard F. *See* Reed, John C., Jr. 04258

Massé, R. *See* Landisman, M. 03980

03943 **Matheson, David S.** A tunnel roof failure in till [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 313-317, illus., 1970.

A failure [in Edmonton, Alberta] of an unsupported section of a tunnel roof in till is described. The failure was preceded by the formation of longitudinal cracks in the tunnel roof and consisted of a series of falls of discrete blocks from the roof. The presence of sand lenses in the till appears to affect adversely the stability of the tunnel roof. — Author's abstract

Matthews, Robert A. *See* Geological Society of Sacramento. 03951

04253 **Mattick, Robert E.** Thickness of unconsolidated to semiconsolidated sediments in Jordan Valley, Utah, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C119-C124, illus., 1970.

A maximum thickness of about 5,000 feet of unconsolidated to semiconsolidated sediments in Jordan Valley is indicated on an isopach map constructed on the basis of previously published geophysical data. The map is based on a gravity survey of Jordan Valley, a seismic-refraction profile in the northern part of the valley, an aeromagnetic survey in the southern part of the valley, and on the data from 10 wells which penetrated underlying consolidated rocks and which are located throughout the valley. — Author's abstract

04300 **Maurice, O. D.** Limestones and dolomites of Quebec: Canadian Mining and Metall. Bull., v. 63, no. 698, p. 711-718, illus., 1970.

Information already known and published is updated. A review of geology of the St. Lawrence Lowlands is given for background, and the location of deposits and producing areas outlined. Precambrian and Cambrian limestones are generally metamorphosed. Paleozoic formations described are: Beekmantown Group, Chazy limestones, Black River Group, and Trenton Group. Principal limestone producing formations are those of the Trenton Group, and the Chazy, Lowville, and Leray Formations. Some younger beds on Anticosti Island are suitable for building stone. Almost all limestone produced is used as crushed stone in concrete or road building although much is good enough for better uses. — ESL

Maxwell, J. R. *See* Douglas, A. G. 04193

03805 **Mayr, Ernst.** Populations, species, and evolution (an abridgment of *Animal species and evolution*): Cambridge, Mass., Belknap Press of Harvard Univ. Press, 453 p., illus., tables, 1970; originally published 1963.

McCallister, Robert H. *See* Yund, Richard A. 04081

McCasland, W. *See* Hartronft, B. C. 04364

04437 **McClure, Duane; Sackett, John.** (compilers). Index to graduate theses on California geology, 1968: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 5, p. 91-94, illus., 1970.

This index, the third supplement to the report published in 1963 (Jennings), contains 58 thesis titles, of which eight are from schools outside California. Titles regarding specific areas are indicated on the accompanying map; those not plotted on the map are either broad regional studies, or topical studies not related to a particular location. — MCM

03913 **McCoy, H. J.; Hardee, Jack.** Ground-water resources of the lower Hillsboro Canal area, southeastern Florida: Florida Bur. Geology Rept. Inv. 55, 44 p., illus., tables, 1970.

All potable water in the lower Hillsboro Canal area in southeastern Florida is obtained from the Biscayne aquifer which extends from the land surface to a depth of about 400 feet and is composed of sand, sandy limestone, shells, and indurated calcareous sand. Most wells obtain adequate supplies from permeable limestone 90-130

feet below land surface. Sea-water intrusion, although a constant threat, has not advanced inland enough to contaminate the municipal well fields of Deerfield Beach and Boca Raton. Large quantities of water can be withdrawn from the interior part of the area without attendant threat of salt-water intrusion; however, continuous observation and evaluation of changes in hydrology should be maintained to protect and efficiently manage the resources. — *from* Authors' abstract

McCreery, R. A. *See* Tan, K. H. 03953

McDonald, Harris R. *See* Phillips, H. Boyd. 04229

04443 **McDougall, Harry.** Volcanoes of Hawaii: Canadian Geog. Jour., v. 80, no. 6, p. 208-217, illus., 1970.

Hawaiian volcanoes are shield volcanoes without the conical shape and destructive capabilities of other types. Volcanism began 5 to 10 m.y. ago along a line of fissures. Action has stopped on the northernmost islands, and they are now formed of limestone on the truncated summits of volcanoes. The flows of low-viscosity magma are of two types, pahoehoe and aa; the former has created lava tubes in places. Other features described include tree molds. Two of the five volcanoes that built the island of Hawaii, Mauna Loa and Kilauea, are still active. They erupt along rift zones as well as from their craters. Origin of the fire pit, Halemaumau, in Kilauea's caldera is described; the most spectacular eruption was in 1959. Work of the Volcano Observatory and instruments used are included. One of the more interesting experiments has been the drilling of holes through the crust of lava formed in craters to sample the molten material. — ESL

McDowell, Fred W. *See* Signer, Peter. 04012

04058 **McEnery, Marie; Lee, John J.** Tracer studies on calcium and strontium mineralization and mineral cycling in two species of foraminifera, *Rosalina leei* and *Spiroloculina hyalina*: Limnology and Oceanography, v. 15, no. 2, p. 173-182, illus., tables, 1970.

Mineral cycling in cultures of two calcareous foraminiferan species was traced in short- and long-range experiments with Ca-45 and Sr-90. Incorporation of these radionuclides as well as S-35 and P-32 was proportional to growth when they were introduced in the range of 1×10^4-1×10^5 dpm per ml of medium. Some Ca-45 and Sr-90 were adsorbed to dead tests. Live individuals of both species were decalcified by treatment with 0.01 percent Na_2EDTA in sea water at pH 8.1; the individuals recalcified and grew when returned to control media. Acetazolamide inhibited Ca but not Sr incorporation into the tests. Under conditions of alkaline pH and low hydrostatic pressure Ca and Sr were tightly bound to foraminiferan tests and did not exchange with environmental ions. — *from* Author's abstract

McGregor, D. C. *See* Norford, B. S. 04100

McHenry, J. Roger. *See* Bruscato, Frank N. 04056

03832 **McKee, Edwin H.; Silberman, Miles L.** Geochronology of Tertiary igneous rocks in central Nevada: Geol. Soc. America Bull., v. 81, no. 8, p. 2317-2327, illus., tables, 1970.

Potassium-argon ages are given for 14 extrusive and 5 intrusive rock units exposed in Lander County, Nevada. Andesitic to quartz latitic lava flows and related hypabyssal rocks are 37 to 33 m.y. old. Rhyolite ash-flow sheets are from about 34 to 22 m.y. old. Basalts and basaltic andesite flows and intrusive rhyolite flow-dome complexes are about 16 to 10 m.y. old. The precision of the ages was evaluated by repeat analyses of the same mineral separate, age determinations of mineral pairs from the same hand specimen, and age determinations on widely spaced samples from the same rock unit. — RWK

04048 **McKinney, Charles N.; Rosenberg, Arthur S.** Simultaneous X-ray emission analysis of P, Si, Ca, Fe, Al, and Mg in phosphate rock using a small computer to correct for matrix variations, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 125-135, illus., tables, 1970.

Phosphate rock from different sources varies widely in composition. This results in a large interelement effect. A mathematical model was developed to correct for matrix variations in each sample. This model utilizes the X-ray intensity from each of the six elements considered and the mass absorption coefficients of the elements to calculate concentrations. Accurate analyses for P, Si, Ca, Fe, Al, and Mg are obtained using this model. The X-ray instrument is interfaced with a small computer that performs the calculations on each sample and prints the results. Sample preparation, standardization and the computer programs used for sample calculation and standardization will be discussed. — Authors' abstract

04043 **McLaughlin, R. E.; Avignone, Joseph M.** Spore succession in a single coal, a critique on sampling: Compass, v. 47, no. 2, p. 99-109, illus., tables, 1970.

Two complete vertical sections of a coal seam were sampled 0.9 mi apart in the same mine and the principal plant microspores identified and tabulated. Whereas the succession determined by frequency distribution is comparable between the two locations, sporomorph occurrences and concentrations vary in each section. Less abundant forms would have been masked or missed by channel sampling. Limited spot sampling very likely would have resulted in significant omissions and erroneous trend interpretation. — Authors' abstract

McLaughlin, W. A. *See* Yeats, Robert S. 04208

04412 **McLeroy, Donald F.** Genesis of Precambrian banded iron deposits, Rio Arriba County, New Mexico: Econ. Geology, v. 65, no. 2, p. 195-205, illus., 1970.

Field and laboratory evaluation of Precambrian banded iron deposits in the Moppin Formation at Cleveland Gulch and Iron Mountain in Rio Arriba County, N.Mex., has indicated formation from hydrothermal solutions by selective replacement of pre-existing banded rock. Some criteria for this theory are: occurrence of iron deposits in metamorphic rocks which are primarily continental volcanic rocks; cross-cutting relations of banded iron bodies to enclosing rocks; proximity of deposits to intrusive rocks; presence of pre-existing banded metamorphic rock composed of quartz bands alternating with chlorite-rich, mica-rich, or other mineral-rich bands and in mineralized sequences presence of magnetite-rich bands with a much greater percentage of these other minerals than the quartz bands; magnetite bands cross-cutting post metamorphic minerals; near absence of iron-rich metamorphic minerals associated with metamorphism of iron-rich sediments. — *from* Author's abstract

04425 **McMaster, W. M.; Hubbard, E. F.** Water resources of the Great Smoky Mountains National Park, Tennessee and North Carolina: U.S. Geol. Survey Hydrol. Inv. Atlas HA-420, 2 sheets, scale 1:125,000, text, 1970.

Sheet 1 contains information on surface water and sheet 2 on ground water of the Great Smoky Mountains National Park area. Ground-water supplies may be developed either from large-diameter wells excavated in weathered material or from wells drilled into the bedrock; the latter are more trouble-free and less subject to pollution. Yield of wells ranges from one to 135 gpm, with median yield about 35 gpm; about one well in six yields 100 gpm or more. Ground water is somewhat higher in dissolved solids than surface water. — MCM

04131 **McNulty, C. L., Jr.; Klenzlen, Geraldine.** An enchodontid mandible from the Eagle Ford Shale (Turonian), Dallas County, Texas: Texas Jour. Sci., v. 21, no. 4, p. 447-453, illus., 1970.

An enchodontid mandible from the upper Eagle Ford Shale (Turonian), consisting of most of the 2 dentaries preserved in undistorted symphysial union, reveals that the

large tubercles, characteristic of the symphysial margin of enchodontids, are actually distally-enlarging processes that arise from each dentary, cross over the symphysial plane, and interlock with one another. Crowns of the laniary teeth are oblique to the dentary margin. A coronal plane through the anterior and posterior edge of a crown intersects the median-vertical plane of the mandible posteriorly at an angle of about 30°. Laniary teeth vary in cross sectional outline from very asymmetric anteriorly to almost symmetric at the 5th (from anterior) tooth. Systematically significant properties conform to *Enchodus lewesiensis* (Mantell), for which this is the first North American report. — *from* Authors' abstract

McQueen, I. S. *See* Branson, F. A. 03910

04428 **McSween, Harry Y., Jr.** Petrology of Charlotte and Kings Mountain belt rocks in northern Greenwood County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 14, no. 3, p. 57-84, illus., tables, geol. map, 1970.

The town of Coronaca is located at the center of this map-area in the Piedmont province. The Coronaca Granite (named here) is emplaced in the Charlotte belt and is bounded on the southeast by biotite gneiss of this belt and on the northwest by amphibolite of the Kings Mountain belt. A norite transects the granite and biotite gneiss, and a serpentinite cuts the latter. Detailed field and microscopic descriptions of all these rocks, as well as projected petrogenesis are given. Biotite gneiss and amphibolite are the oldest rocks and were produced by regional metamorphism. The granite probably intruded during the last stages of a Permian metamorphic episode. The serpentinite was produced by deuteric alteration, but the relative age is uncertain. The norite represents late-stage igneous activity, after the Permian. — ESL

04083 **Medlin, J. H.; Suhr, N. H.; Bodkin, J. B.** Determination of rubidium in silicate materials by atomic absorption spectrophometry: Chem. Geology, v. 6, no. 2, p. 143-148, illus., tables, 1970.

The determination of rubidium in silicate materials by means of a $LiBO_2$ fusion is described. The method is useful in geochronologic studies where preliminary rubidium contents are needed. The results compare favorably with values obtained from flame photometry, X-ray fluorescence, and neutron activation. Precision expressed as the coefficient of variation is 2-3 percent. — Authors' abstract

Mehnert, Harald H. *See* Lipman, Peter W. 03777

04341 **Meighan, Clement W.** Obsidian hydration rates: Science, v. 170, no. 3953, p. 99-100, illus., table, 1970.

Issue is taken with Johnson's statement (ibid., v. 165, no. 3900, p. 1354-1356, 1969) that the Friedman hydration formula is universally valid. Empirical evidence indicates that archeologists who rely on the formula for determining the age of obsidian specimens will get wrong answers some of the time. A table of values comparing ages determined by this method with ages determined with the linear rate method is presented. — GV

Melhorn, Wilton N. *See* Johansen, Nils I. 03854

04041 **Merschat, Carl E.** Mineralogy of selected ceramic clays from West Tennessee: Compass, v. 47, no. 2, p. 70-80, illus., tables, 1970.

A study of ceramic clays from the well-known mining area in West Tennessee confirms the identity of the principal minerals and provides new information on relative abundance and minor constituents. Recognition of stratigraphic trends in mineral distribution and reconstruction of possible developmental stages in the history of these deposits are made possible through serial sampling. — Author's abstract

04353 **Mesri, G.; Olson, R. E.** Shear strength of montmorillonite [with French abs.]: Géotechnique, v. 20, no. 3, p. 261-270, illus., tables, 1970.

Artificially sedimented Wyoming bentonite was used to investigate the effect of physico-chemical variables on shear strength properties of montmorillonite, by triaxial compression tests on Ca and Na montmorillonite at various electrolytic concentrations. For the influence of type of adsorbed cation and concentration of electrolyte in free pore water, undrained tests were used with pore water pressure measurements. Effective-stress failure envelopes Ca and Na were curved; decrease in their slopes, from 15° to 10° and 4° to 0° respectively in the range of stress studied, could be due to greater parallelism of clay plates at higher consolidation pressures. Drained triaxial tests on Ca montmorillonite yielded the same effective-stress failure envelope as did undrained; overconsolidated specimens in undrained tests were stronger than normally consolidated ones at the same effective normal stress at failure. — *from* Authors' abstract

04323 **Meyer, W. T.; Evans, D. S.** Determination of trace mercury in soil and rock media — Discussion [of paper by R. Z. Pyrih and R. E. Bisque, 1969]: Econ. Geology, v. 65, no. 3, p. 357-358, 1970.

The paper under discussion (ibid., v. 64, p. 825-828, 1969) was abstracted in Abs. North American Geology, April 1970. — VSN

03879 **Meyerhoff, A. A.** Continental drift — [Pt.] 2, High-latitude evaporite deposits and geologic history of Arctic and North Atlantic Oceans: Jour. Geology, v. 78, no. 4, p. 406-444, illus., tables, 1970.

Extending the argument against the hypothesis of continental drift (ibid., v. 78, no. 1, p. 1-51, 1970), the existence of the Gulf Stream-North Atlantic Drift system from late Proterozoic to Permian time is inferred from the presence of widespread evaporite deposits in the high latitudes. Neither this nor the several sills across the Arctic and North Atlantic Oceans appear to fit with the continental drift hypothesis. — REW

04262 **Meyrowitz, Robert.** A microprocedure for the determination of carbon dioxide in minerals, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C183-C185, illus., 1970.

Carbon dioxide in minerals is determined after hydrochloric acid decomposition by a gravimetric microprocedure using a modified Schroedter alkalimeter as reaction flask. The carbon dioxide after purification is absorbed in a tube containing Ascarite (sodium hydroxide on asbestos). — Author's abstract

04435 **Michelson, R. W.; Polta, H. J.; Peterson, Orin.** Evaluating the economic availability of Mesabi Range iron ores with computerized models: U.S. Bur. Mines Inf. Circ. 8480, 99 p., illus., tables, 1970.

Frequency distribution of iron and silica contents, and fraction of iron recoverable from non-magnetic taconite are related by statistical methods to overburden ratios and costs of mining and processing to derive a relation between iron reserve quantities and iron unit cost. Results expressed as billions of tons of iron pellets recoverable from magnetic and nonmagnetic taconite are tabulated and graphed for a range of iron unit costs. Other tables and graphs present many details of the data and effects of several variables on costs. — APB

Mickle, David G. *See* Johnson, Thys B. 04290

Migdisov, A. A. *See* Ronov, A. B. 03952

Milledge, H. J. *See* Harris, J. W. 04409

04157 **Miller, C. N.** Structurally-preserved cones and vegetative organs of *Pinus* from the Eocene of British Columbia [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 759, 1970.

04393 **Miller, Charles N., Jr.** *Picea diettertiana*, a new species of petrified cones from the Oligocene of western Montana: Am. Jour. Botany, v. 57, no. 5, p. 579-585, illus., table, 1970.

These are the first structurally-preserved ovulate cones of *Picea* to be reported from the Tertiary. They are 5.0-5.8 cm long and 1.6-1.8 cm at their widest diameter. Numerous ovuliferous scales are arranged spirally around the axis and each bore two winged seeds. The bract subtending the scale is 4.0-7.0 mm long and is fused to the scale for 1.0 mm. The base of the bract is inflated on the abaxial side extending for about 1.0 mm between the seeds of the adjacent scales. Both the scales and their subtending bracts are recurved at their point of divergence from the axis. The ovuliferous scales taper gradually to a point, and the thickness of the tissues at the scale apex indicates that they were woody. Anatomically, the silicified cones are very similar to those of Recent species. — *from* Author's abstract

Miller, D. K. *See* Manuel, O. K. 04273

04045 **Miller, Don R.** Preparation of carbonate samples for geochemical trace element analysis: Compass, v. 47, no. 2, p. 125-127, table, 1970.

The problem of contamination of samples used in geochemical analysis is examined and some techniques designed to deal with the problem are discussed. — Author's abstract

03864 **Miller, G. A.** Ground water in Death Valley, California, *in* Geologic guide to the Death Valley area, California — Geol. Soc. Sacramento, Ann. Field Trip Guidebook 1970: Sacramento, Calif., Geol. Soc. Sacramento, p. 33-39, illus., 1970.

Death Valley is the drainage sump for surface and subsurface flow for 9,000 sq mi of desert terrane. Valley fill consists of coarse-grained alluvial-fan deposits on the slopes, and fine-grained alluvium and evaporites in the valley floor. These Tertiary and Quaternary deposits are several thousand feet thick. Ground water occurs in all rock types; the occurrence, abundance, and quality are related to the geologic history. Water-bearing characteristics of several rock types are summarized. Source of ground water is local precipitation and underflow from distant drainage basins. Largest springs are associated with high-angle faults. Several springs appear to be discharge points of a large interbasin ground-water system. — ESL

03998 **Miller, George J.** The Rancho La Brea Project, 1969-70: Los Angeles County Mus. Nat. History Quart., v. 9, no. 1, p. 26-30, illus., 1970.

In June 1969, these tar pits were reopened and it is hoped that many gaps in data as well as in collections of ice-age animals may be filled; no other late Pleistocene site has produced the quantity or variety of specimens that have been recovered here. Specimens from Rancho La Brea have not been mineralized, and the microstructures are perfectly preserved. The tar pits were active for at least the last 40,000 years of the Pleistocene, and the major parts of the extinctions were about 10,000 yr ago. Excavation down to 50 feet is planned with foot by foot soil profiles and petrographic analysis of soil samples at six inch intervals. Across the street from the Project, excavation for a building encountered a rich marine deposit 50 feet below the surface. Carbon-14 dates prove that a fossil woman found in the pits died 9,000 yr ago, and an animal cut by a primitive stone tool was dated at 15,200 yr B.P. — ESL

Miller, R. F. *See* Branson, F. A. 03910

Miller, R. J. *See* Lincoln, J. B. 04439

04042 **Miller, Robert C.** Analysis of sandstones in the Dowelltown Member of the Chattanooga Shale, Macon County, Tennessee and vicinity: Compass, v. 47, no. 2, p. 84-89, illus., tables, 1970.

A study was made of the areal and stratigraphic distribution of the sandstones in the Dowelltown Member of the Chattanooga Shale formation in the Highland Rim sec-

tion, north-central Tennessee. The study shows the effects of pre-Chattanooga topography and Dowelltown sedimentation on the development of the formation during Late Devonian-Early Mississippian time. The morphological variation in sandstone types is discussed in relation to position and source of the original deposits. A reconstruction of the order of events and physical setting is based on the results of the analysis. — Author's abstract

04411 **Milovic, D. N.; Touzot, G.; Tournier, J. P.** Stresses and displacements in an elastic layer due to inclined and eccentric load over a rigid strip [with French abs.]: Géotechnique, v. 20, no. 3, p. 231-252, illus., tables, 1970.

Using the finite element method, a set of influence factors for the stresses in, and the surface displacement of, an elastic layer of finite thickness have been obtained. Stresses and displacements due to inclined and eccentric load over a rigid strip have been calculated for the ratio $H/B = 1.0$, 2.0, and 3.0, where H is the thickness of the compressible layer and B is the width of the rigid strip foundation, and for Poisson's ratio $\mu = 0.005$, 0.30, and 0.45. The values of the stress and displacement coefficients are given in tabular form and some of them are also presented graphically. — Authors' abstract

04406 **Minato, Susumu; Kawano, Minoru.** On the constitution of terrestrial gamma radiation: Jour. Geophys. Research, v. 75, no. 29, p. 5825-5830, illus., tables, 1970.

Pulse-height distributions due to terrestrial γ radiation were determined by using a 30 x 30 NaI(Tl) scintillation counter. The distributions were unfolded by a response matrix method, and 'true' photon spectra were obtained. Accurate ionization intensities due to the terrestrial γ radiation were calculated from the spectra, and these values were compared favorably with those measured with an ionization chamber. Mean energy of the terrestrial γ radiation was also calculated from one of those spectra. Primary components due to the uranium and thorium series and to potassium 40 were successfully subtracted from the true spectrum to obtain the scattered component of the terrestrial γ radiation and the buildup factor in the soil. — Authors' abstract

03784 **Misch, Peter.** Paracrystalline microboudinage in a metamorphic reaction sequence: Geol. Soc. America Bull., v. 81, no. 8, p. 2483-2485, illus., 1970.

A reaction sequence involving different mineral phases may be used as a relative time scale against which a deformational sequence can be plotted and tested as paracrystalline. In the example reported, deformation involves microboudinage due to elongation parallel to the schistosity, and the reaction sequence is from relict primary clinopyroxene to tremolite to Mg-chlorite in a regionally metamorphosed ultramafic rock from the Northern Cascades of Washington. — Author's abstract

Mitchell, R. J. *See* Eden, W. J. 03941

03942 **Mitchell, R. J.** On the yielding and mechanical strength of Leda clays [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 297-312, illus., tables, 1970.

The pronounced yielding observed in laboratory tests on Leda clay has been associated with the destruction of cementation bonds in the clay. Triaxial test data presented in this paper show that a yield curve can be established for a Leda clay. The form of the yield curve deviates from that expected for an isotropic material, and the pre-yield strains are shown to be different for vertically and horizontally oriented specimens. The shear strength of the clay is dependent on the mean normal stress at failure. A portion of the failure envelope is different for specimens orientated in different directions and this 'strength anisotropy' is associated with anisotropic yielding. — Author's abstract

03985 **Moench, Allen F.; Kisiel, Chester C.** Application of the convolution relation to estimating recharge from an ephemeral stream: Water Resources Research, v. 6, no. 4, p. 1087-1094, illus., table, 1970.

A linear model that permits calculation of recharge to the water table from a source of finite width and infinite length uses water level measurements made in an observation well near the source, and independently estimated aquifer constants. The method requires determination of the input given the output (water level measurements) and the impulse response as a function of space and time. The latter is derived from the linear equations of ground-water motion for the particular geometry of this study. The input is obtained from the discrete form of the convolution integral by using the synthetic division method and is then summed over the appropriate time period to obtain total recharge. For the particular recharge event studies, results agree satisfactorily with an independent estimate of recharge and demonstrate that the convolution relation has practical application to ground-water flow problems. — Authors' abstract

04203 **Monger, J. W. H.** Hope map-area, west half (92HW1/2), British Columbia: Canada Geol. Survey Paper 69-47, 75 p., illus., tables, geol. map, 1970.

The gneissic and granitic core of the Cascade Mts. is flanked by belts of pre-Middle Devonian to Recent sedimentary and volcanic rock. The core widens northwards and merges with granitic and highly metamorphosed rocks of the Coast Mts. Most stratified rocks are marine, except for continental Lower Tertiary clastics and volcanic rocks in some places; Pleistocene to Recent deposits fill major valleys. Granitic rocks were emplaced in Upper Jurassic-Lower Cretaceous in the eastern part, in Upper (?) Cretaceous along the Cascade axis, and in late Eocene to Miocene. Early diastrophic events were metamorphism in pre-Middle Devonian, uplift in Permo-Pennsylvanian, and hiatuses between Lower Permian and Upper Triassic and in Upper Jurassic and Lower Cretaceous. The present structural pattern was established in mid-Cretaceous to early Tertiary, with folding and thrusting on the west and folding and reverse faulting east of the Cascades. Few mineral deposits have been exploited. — *from* Author's abstract

04141 **Montgomery, Arthur.** Swarthmore-Leidy collection [Pt. 1]: Mineralog. Rec., v. 1, no. 2, p. 36, 38, 44, 1970.

The remnants of the Joseph Leidy collection of minerals, unearthed at Swarthmore College, Pa., was sent to Lafayette College as a "permanent loan." Nothing of great value appeared, but many beautifully crystallized minerals, some rare species, and others representative of early classic localities, enlarged and strengthened the collection in the geology department at Lafayette. Descriptive notes will be given in the concluding installment of this report, but a few surprising discoveries are mentioned here. Labelling is remarkably complete for many American occurrences. Quality of the roughly 1300 specimens proved so high that 500 were placed in the systematic collection, 150 in the Pennsylvania collection, and 100 in the student study collection. Relegated to first-class duplicate status were 500, half of which went to Millersville State College for teaching and display. — GDC

04007 **Mooney, Harold M.; Craddock, Campbell; Farnham, Paul R.; Johnson, Stephen H.; Volz, Gary.** Refraction seismic investigations of the northern midcontinent gravity high: Jour. Geophys. Research, v. 75, no. 26, p. 5056-5086, illus., 1970.

Eighty-seven seismic refraction profiles define the geologic structure in the upper crust associated with the midcontinent gravity high in Minnesota and Wisconsin. The presence of the St. Croix horst and its flanking sedimentary basins beneath the midcontinent gravity high and its parallel gravity lows is confirmed. A horst-like structure beneath the high in southern Minnesota is demonstrated. An important sedimentary basin (at least 2.6 km sediment thickness) east of the St. Croix horst is confirmed. Middle Keweenawan basaltic rocks occur west of the Douglas fault only locally beneath the Upper Keweenawan sediments. Oronto group equivalents occur only locally at depth in the western basin, in small basins atop the Middle Keweenawan volcanics of the St. Croix horst, and extensively in the eastern basin. Bayfield group equivalents occur extensively at shallow depths in both basins. — DBV

Mooney, Harold M. *See* Craddock, Campbell. 04382

04247 **Moore, William J.** Phlogopite and actinolite in latitic dike rocks, Bingham mining district, Utah, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C61-C69, illus., tables, 1970.

Latitic dike rocks west of Bingham stock contain primary phlogopite and biotite with actinolite, augite, hornblende, magnetite, and (or) traces of hematite. About 5 percent of the mica occurs in composite crystals: cores of brownish-yellow biotite, some resorbed, are rimmed by euhedral overgrowths of pale-yellowish-green phlogopite. These rocks have a fluidal texture resulting from subparallel alinement of acicular actinolite in the groundmass. Although not undersaturated, the dikes contain slightly less SiO_2 and Al_2O_3 and slightly more MgO, total alkalies, and CO_2 than larger monzonitic stocks in the Bingham Canyon area. The model proposed to explain textural and compositional features of the dikes requires assimilation of magnesian carbonate rocks by a latitic melt with oxygen fugacities controlled externally during later stages of crystallization. — *from* Author's abstract

04346 **Morse, S. A.** Alkali feldspars with water at 5 kb pressure: Jour. Petrology, v. 11, no. 2, p. 221-251, illus., tables, 1970.

An isobaric eutectic melting behavior is indicated for alkali feldspars by liquidus, solidus, and solvus data from experiments with synthetic material heated with water at 5 kb. Melting begins at 703 ± 2°C, recalculated composition being $Or_{28.5}$ (wt percent). The liquidus of albite-H_2O at 5 kb is 758 ± 3°C. The alkali feldspar solvus has a calculated critical temperature of 730°C and critical composition of Or_{34}; feldspars produced are structural equivalents of low-sanidine. For system Ab-Or-H_2O, the critical line intersects beginning of melting curve at 4.2 kb, 715°C, the minimum conditions for coexistence of two feldspars and liquid in this system. Slope of the critical line is 18.3°C/kb. Intersections with kyanite-sillimanite and andalusite-sillimanite curves are criteria for estimating limits of pressure and temperature for various crustal rocks. Assuming isobaric crystallization of feldspars in the water-undersaturated region results in water enrichment of the liquid to the saturation point, two feldspars will eventually crystallize from haplosyenitic liquids with finite initial water content. — MS

04107 **Mueller, George.** Geological aspects of the problem of origin of life [abs.], *in* Alaska Sci. Conf., 20th, College, 1969, Proc.: Sci. Alaska 1969, p. 309, 1970.

04440 **Muller, J. E.; Jeletzky, J. A.** Geology of the Upper Cretaceous Nanaimo Group, Vancouver Island and Gulf Islands, British Columbia: Canada Geol. Survey Paper 69-25, 77 p., illus., tables, geol. map, 1970.

The group is newly subdivided into four succeeding transgressive cycles, each of which contains most of the five facies recognized. With some changes in correlation, for the double formational successions of the Nanaimo and Comox basins, two formational names have been retained for each cycle. Economic coal deposits were formed in the Nanaimo Group in the Comox basin during the first cycle, and in the Nanaimo basin during the second. Six faunal zones and subzones are established on ammonites and inocerami. In the earlier cycles the basin occupied the southwestern part of the Strait of Georgia and adjacent areas, with a southward oceanic connection. In later cycles, parts of northern Vancouver Island and the mainland were also submerged, but the basin was open to the north. The structure features northwesterly tilted blocks, separated by northwesterly longitudinal normal faults and by northeasterly cross faults. — ESL

Munn, R. W. *See* Harris, J. W. 04409

Munoz, Elaine F. *See* Silverman, Melvin P. 04442

Murdock, J. N. *See* Eaton, J. P. 04420

03829 **Murphy, Andrew J.; Sykes, Lynn R.; Donnelly, Thomas W.** Preliminary survey of the microseismicity of the northeastern Caribbean: Geol. Soc. America Bull., v. 81, no. 8, p. 2459-2463, illus., table, 1970.

A survey of microearthquakes of the Virgin Islands and eastern Puerto Rico showed that it is possible to find quiet recording sites for high-gain, high-frequency seismographs and to record as many as 10 to 15 micro-events per day. A site at Lameshur Bay, St. John, Virgin Islands, was as quiet as some of the best sites occupied in western North America. Microearthquake activity approximately coincided geographically with activity for larger earthquakes from 1900 to 1964. These events were located along the Anegada trough, the Puerto Rico trench, and the northern end of the Lesser Antillean arc. — Authors' abstract

Murphy, John F. *See* Houston, Robert S. 04257

Murthy, M. K. *See* Smith, Donald E. 04404

04362 **Nafziger, Ralph H.** Geology along the Rogue River from Merlin to Whiskey Creek: Geol. Soc. Oregon Country News Letter, v. 36, no. 9, p. 63-65, 1970.

The trip started at the campground on the Cretaceous quartz diorite Merlin stock, crossing the contact between the diorite and Upper Jurassic Galice Formation, a dark-gray to black, thin-bedded slaty shale. Sheared serpentine along the road indicates the East and West Hellgate fault zones. The cause-and-effect relation of the faulting and serpentine is unknown. A mass of amphibolite and gabbro with quartz veins was examined, and several old placer excavations were noted. The contact between the Galice and Rogue Formations is characterized by barite, pyrite, and chalcopyrite, with some sphalerite and galena. About 15,000 feet of Upper Jurassic metavolcanic rocks comprise the Rogue Formation. Loop folds and crumpling are evident at the exposed fault contact between the Rogue and Dothan Formations. Controversy concerning the age relations of the three Jurassic formations is reviewed. — ESL

04413 **Naldrett, A. J.; Bray, J. G.; Gasparini, E. L.; Podolsky, T.; Rucklidge, J. C.** Cryptic variation and the petrology of the Sudbury nickel irruptive: Econ. Geology, v. 65, no. 2, p. 122-155, illus., tables, 1970.

(1) Textural evidence indicates that the south range norite, felsic norite, and oxide-rich and upper gabbros are cumulus rocks. (2) Phase layering is present in all exposed portions of the irruptive; cumulus minerals appear and disappear at different levels, defining distinct, continuous horizons. (3) Cryptic variation in plagioclase, augite, and hypersthene compositions in all cases tends to enrich the minerals in their lower melting point end-members upwards in the sequence. These observations demonstrate that the norites and gabbros have formed by gravitational crystal settling, a process consistent with either the folded-sill or funnel-shaped intrusion hypotheses. — *from* Authors' text

03925 **Naylor, Richard.** Radiometric dating of pennine-type nappes in the northern Appalachians, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 230, 1970.

Dating of large pennine-type nappes in the central metamorphic belt of the northern Appalachians indicates a very abrupt onset for Acadian deformation terminating a long period of relatively quiet geosynclinal deposition. Little if any of the deformation of the nappes occurred prior to deposition of Lower Devonian rocks which are incorporated in the synclinal folds of the nappes, although heat (the nappes are associated with middle- and high-grade regional metamorphism) may have been building up gradually. An intrusive body (Prescott Complex) of gabbro, quartz diorite, granodiorite, and quartz monzonite crosscuts the limbs of the nappe. Preliminary Rb-Sr whole-rock data indicate the granitic rocks in this complex were emplaced 385 ± 20 m.y. ago. These data provide a minimum age for emplacement of the nappe which is very close to the maximum age indicated by the stratigraphic data. — Author's summary

04176 **Nelson, C. Hans.** Potential development of heavy metal resources in the northern Bering Sea *in* Alaska Sci. Conf., 20th, College, 1969, Proc.: Sci. Alaska 1969, p. 366-376, 1970.

Most of the Chirikov Basin is remote from onshore bedrock sources of gold, and possible bedrock sources below the sea floor are covered by Tertiary sediments. The most promising offshore gold concentrations occur in areas of glacial drift that have been reworked. The richest deposits are in relict surface sediments where Holocene deposition has been prevented by current action. These gold-rich relict sediments are found mainly on slight topographic highs over glacial drift derived from rich onshore placer deposits. Evaluation of the potential of these offshore deposits was the subject of a detailed report (Nelson and Hopkins, 1969) of which the first part of this paper is a resumé. The evaluation is based on more than 700 large samples and 50 boreholes. Potentially economic concentrations of tin have been detected in the Cape Prince of Wales area. — ESL

Nelson, L. A. *See* Daniels, R. B. 03990

04306 **Nelson, Leonard M.** A method of estimating annual suspended-sediment discharge, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C233-C236, illus., 1970.

A simple method is proposed for estimating annual suspended-sediment discharge during years for which stream-flow records are available but for which sediment records are not available. Readily accessible information on the parameters of annual peak and annual mean water discharges is used with the available sediment records to estimate the average annual suspended-sediment discharge. The relation between the two parameters and the annual suspended-sediment discharge is well defined for many streams. This relation does not fit all streams, however, and a thorough understanding of a basin's geologic and hydrologic characteristics is needed for application of the method proposed. — Author's abstract

Nelson, Lloyd S. *See* Blander, Milton. 04119

03933 **Nichols, J. D.; Stone, J. F.** Evaluation of soil moisture measurements in Oklahoma as soil characteristics for classification: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 638-641, illus., table, 1970.

Soil moisture measurements by neutron probe at weekly intervals at four sites were evaluated as soil moisture characteristics specified in the new soil classification system. Cumulative days dry (where moisture content dropped below estimated wilting point) were related to observed annual precipitation. Data for each site for a several year period yielded close fitting linear regression lines useable in determining days dry for classification purposes. — Soil brief

Nielsen, H. *See* Schiller, W.-R. 04321

04132 **Nielson, Dennis N.** Washboard moraines in northeastern North Dakota: Compass, v. 47, no. 3, p. 154-162, illus., 1970.

The term "washboard moraine" has been applied to small transverse till ridges occurring in many glaciated regions. Washboard moraines in the this area are generally 4 to 15 feet high, are spaced 250 to 550 feet apart, and are subdued, discontinuous, irregular ridges paralleling each other. They are composed of till that has preferred pebble orientations generally unrelated to regional ice-flow direction. Some washboard moraines cross eskers and drumlinoid features. Slopes range from 2° to 6° and show no proximal or distal slope variation. Based on field information, washboard moraines appear to be remnant shear moraines, deposited from a superglacial position by shearing of active ice over stagnant ice in marginal positions, forming debris-laden shear planes. This debris is released by ablation, forming ice-cored shear moraines, preservation of which is dependent upon the plasticity of the till and the rate of ablation. — *from* Author's abstract

04231 **Nigrini, Andrew.** Diffusion in rock alteration systems — [Pt.] 1, Prediction of limiting equivalent ionic conductances at elevated temperatures: Am. Jour. Sci., v. 269, no. 1, p. 65-91, illus., tables, 1970.

Equations for computing mass transfer as a function of activity gradients are reviewed. The calculations require prediction of limiting equivalent ionic conductances. Where few data are available, linear correlations of limiting equivalent ionic conductances with third law entropies, with entropies of hydration, and with charge to radius ratios, can be used. A conductance correspondence principle provides for the prediction of high temperature limiting equivalent ionic conductances from corresponding values at 25°C. The coefficients required for such predictions are given for temperatures of 60°, 100°, 200°, 250°, and 300° C for monovalent, divalent, and trivalent cations, halide anions, and monovalent and divalent oxyanions. — *from* Author's abstract

03856 **Noger, M. C.; Ponsetto, Louis R.** Field trip No. 1, Geologic features of southeastern Kentucky — Pt. 2, Geology of middle and upper Paleozoic rocks along Pine Mountain front, Harlan to Pineville; Paleozoic rocks along Interstate 75, London to Lexington, *in* Guidebook for field trips — Geol. Soc. America, Southeastern Sec., 18th Ann. Mtg., Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, p. 11-15, illus., geol. maps, 1970.

Presented here is a generalized stratigraphic section from London to Lexington, with linear descriptive segments adapted from quadrangle maps of the current cooperative program of the Kentucky and U.S. Geological Surveys. The road log indicates optional stops, shown on generalized geologic strip map in pocket, where mapped lithologic units can be studied. — GDC

Nooner, D. W. *See* Oró, J. 04089

Nooner, D. W. *See* Oró, J. 04194

04222 **Noorany, Iraj; Gizienski, Stanley F.** Engineering properties of submarine soils, state-of-the-art review: Am. Soc. Civil Engineers Proc., v. 96, paper 7536, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1735-1762, illus., tables, 1970.

The scope of the application of soil mechanics to ocean engineering is reviewed. Topographic features of the oceans are briefly analyzed and methods of sampling sea-floor deposits as well as in-situ testing procedures are presented. The available data on index properties, shear strength and consolidation characteristics of near shore and deep-sea submarine soils are presented. Comparison is made between engineering properties of submarine soils and terrestrial soils. — ASCE abstract

04100 **Norford, B. S.; Braun, W. K.; Chamney, T. P.; Fritz, W. H.; McGregor, D. C.; Norris, A. W.; Pedder, A. E. H.; Uyeno, T. T.** Biostratigraphic determinations of fossils from the subsurface of the Yukon Territory and the Districts of Mackenzie and Franklin: Canada Geol. Survey Paper 70-15, 19 p., illus., 1970.

Identifications and age determinations are presented for fossils from twenty wells in the Districts of Mackenzie and Franklin and the Yukon Territory. Ages range from Middle Cambrian to Late Cretaceous and are based on identifications of spores, pollen, conodonts, ostracods, foraminifers, corals, brachiopods, and trilobites. — Authors' abstract

Norris, A. W. *See* Norford, B. S. 04100

Nur, Amos. *See* Aki, Keiiti. 04337

Obradovich, J. D. *See* Izett, G. A. 04259

04416 **Ohmoto, Hiroshi; Rye, Robert O.** The Bluebell mine, British Columbia — [Pt.] 1, Mineralogy, paragenesis, fluid inclusions, and the isotopes of hydrogen, oxygen, and carbon: Econ. Geology, v. 65, no. 4, p. 417-437, illus., table, 1970.

Lead-zinc ore bodies at this mine are replacements of Cambrian limestone. Mineralization followed Tertiary intrusion of lamprophyre dikes, and was in three periods. Fluid inclusions and isotopic composition of Period-III quartz and carbonate

samples indicate: Temperatures of fluid were between 450° and 320°C; salinity changed with temperature decrease from 10 wt percent equivalent NaCl at 450°C to ca. 3 wt percent at 320°C. Temperature and salinity in Period-II were probably higher. PH_2O of hydrothermal fluids was between 300 and 800 atm; depth of Bluebell limestone during ore deposition was about 6 km. Temperature gradient within the hydrothermal system was less than 65°C/km. Oxygen isotopic composition of Period-III fluids changed with time and temperature, suggesting principally meteoric fluids; carbon isotopic composition was relatively uniform, and carbon may have been juvenile. — VSN

03866 **Okaya, Y.** Anomalous dispersion in diffraction studies, an introduction, *in* Crystallographic computing — Internat. Summer School, Ottawa, 1969, Proc.: Copenhagen, Denmark, Munksgaard, p. 127-131, tables, 1970.

Anomalous dispersion, once considered a source of nuisance, has attained a deserving importance in diffraction studies. Some introductory remarks on the theory and applications of the anomalous dispersion methods are made. Since the majority of diffraction studies involving use of anomalous dispersion are concerned with X-ray diffraction, this report devotes most of its space to X-ray crystallographic studies. However, the effects are also important in neutron and electron diffraction phenomena, and many interesting problems in these areas have been encountered; these problems are touched upon. — *from* Author's abstract

03976 **Oliver, Jack.** Recent earthquake prediction research in the U.S.A., *in* Earthquake mechanics (T. Rikitake, editor), a symposium, Madrid, Spain, 1969: Tectonophysics, v. 9, nos. 2-3, p. 283-290, 1970.

Recent research in earthquake activity in the United States has led to the following observations: (1) A new level of understanding of earthquake mechanism, particularly along the San Andreas fault, which indicates the importance of fault creep or slow slippage without accompanying large earthquakes; (2) the importance of water or other interstitial fluid; (3) the bearing of global tectonics — continental drift, seafloor spreading, transform faults, etc. — on earthquake mechanism and prediction; (4) the importance of a multidisciplinary approach using not only seismologic data but also geodetic, geomagnetic, field geology, tectonics, and laboratory studies, and the value of carrying out such measurements on widely different scales; and (5) development of new techniques for observing various geophysical or geological parameters. — VSN

04149 **Oliver, R. T.; Clayton, A. G.** Direct determination of fluoride in miscellaneous fluoride materials with the Orion fluoride electrode [with French and German abs.]: Anal. Chim. Acta, v. 51, no. 3, p. 409-415, illus., tables, 1970.

The Orion fluoride electrode was used to measure major concentrations of fluoride in samples containing aluminum, calcium and silicon without prior separation. Liquid samples were mixed with a total ionic strength buffer and direct potentiometric readings were compared to a calibration curve. Samples of AlF_3, Na_3AlF_6, and SiO_2 (containing 20 percent fluoride) were fused with sodium carbonate and dissolved in water or a total ionic strength buffer. For samples containing alumina which may not be rendered soluble by a carbonate fusion, a borate-carbonate fusion was used. Interferences were masked by the addition of equal concentrations of the interfering ion during the preparation of the standards. Results are shown for various samples analyzed by this technique and by the Willard-Winter distillation and titration. The direct method is accurate to within ±3 percent of the amount present. — Authors' abstract

Olsen, E. *See* Bunch, T. E. 04438

Olson, R. E. *See* Mesri, G. 04353

Olson, R. J. *See* Oró, J. 04089

03800 **Olson, Ralph E.** A geography of water: Dubuque, Iowa, Wm. C. Brown Co. Publishers, 132 p., illus., 1970.

04020 **Olsson, Axel A.** The cancellariid radula and its interpretation: Palaeontographica Americana, v. 7, no. 43, p. 19-26, illus., 1970.

This study of cancellariid radula presents a new approach to research upon radulae and their proper illustration by photomicrographs of the whole structure rather than by sketches of a few parts. It also demonstrates that the so-called family Cancellariidae warrants recognition as a separate and distinct ordinal group of the Prosobranchia. The radula in this group is unique, and a new term based upon radular structure is necessary. For this order, the name Nematoglossa is proposed in allusion to the threadlike shape of its highly modified radular teeth. The food requirements of the cancellariids are unknown, and until the mode of life becomes known more fully the functional operation of the radula remain conjectural. — *from* Author's abstract

03792 **O'Neil, James R.; Hedge, Carl E.; Jackson, Everett D.** Isotopic investigations of xenoliths and host basalts from the Honolulu Volcanic Series: Earth and Planetary Sci. Letters, v. 8, no. 3, p. 253-257, illus., tables, 1970.

Oxygen, carbon and strontium isotope ratios point to a ground-water origin for the carbonates found in Hawaiian Volcanic Series rocks. Strontium isotope ratios in the xenoliths and hot basalts indicate a genetic relationship between them. — Authors' abstract

O'Neill, M. E. *See* Eaton, J. P. 04420

04256 **Ong, H. Ling; Swanson, Vernon E.; Bisque, Ramon E.** Natural organic acids as agents of chemical weathering, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C130-C137, illus., table, 1970.

Naturally occurring organic acids, commonly called "humic acids," are effective agents in the colloidal transport of copper, lead, zinc, iron, and aluminum. Concentrations of organic acids in the range of 4-40 ppm carbon in water can effect increases of several orders of magnitude in the amount of these metals "stabilized" in solution. Stability of these metal-organic colloids increases with increasing organic acid concentration and increasing pH. The optimum condition for the stability, in general, lies between pH 6 and pH 9. Chemical weathering due to differential leaching of cations by organic acids may be largely responsible for the formation of sedimentary aluminum and lateritic deposits, which are restricted to tropical and subtropical regions where organic acids are abundant. — Authors' abstract

03812 **Ontario Water Resources Commission.** Bedrock well yields, Lake Ontario drainage basin, Ontario-New York: Toronto, Ontario Water Resources Comm., scale 1:500,000, 1970.

Oriel, Steven S. *See* Peterson, Donald L. 04252

04089 **Oró, J.; Nooner, D. W.; Olson, R. J.** Hydrocarbons in meteorites, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 507-521, illus., 1970.

A study of the chromatograms and mass spectrograms from analysis of 29 meteorites indicates: (1) There are pristane and phytane in most meteorites, norpristane in most type I and some type II meteorites, and isoprenoids in Boriskino, Mighei, Murray, Santa Cruz, Mokoia, and Odessa. (2) Hydrocarbons in Orgueil are heterogeneous quantitatively and quasi-homogeneous qualitatively, and exhibit odd over even C-number preference in alkanes; Ivuna, Alais, and Warrenton have possible bimodal hydrocarbon distributions. (3) Type II were the only group in which members have consistently similar chromatographic patterns for alkane content. (4) Many meteoritic hydrocarbon patterns were similar to patterns given by fossil hydrocarbons. (5) There is no correlation between amount of paraffinic hydrocarbons extracted and amount of material in corresponding benzene eluate. — *from* Authors' conclusions

04194 **Oró, J.; Nooner, D. W.** Aliphatic hydrocarbons from the Pre-Cambrian of North America and South Africa, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 493-506, illus., 1970.

Results are reported of study of samples from the 2.7 b.y. old Soudan Iron-Formation of Minnesota and the 3.2 b.y. old Fig Tree series of South Africa for aliphatic hydrocarbons as biologic markers. Saturated isoprenoids, norpristane, pristane, phytane, and normal alkanes were found in both formations, and also monoalkanes in the Fig Tree. It is concluded that the hydrocarbons are not surface contaminants; they or their precursors in the Fig Tree and Gunflint chert (Ontario) may have been deposited with the sediments, on the basis of C-13/C-12 ratios of organics and by correlation of black color, microfossils, and hydrocarbon content (only partially true of the Soudan which has different C-isotope ratios); similarity of patterns indicates that the same or related organisms produced hydrocarbons from the Soudan and Fig Tree; and additional research is necessary to prove that these date from deposition and their biologic or abiologic origin. — VSN

04385 **Ortiz, Jaime; Luthin, James N.** Movement of salts in ponded anisotropic soils: Am. Soc. Civil Engineers Proc., v. 96, paper 7530, Jour. Irrigation and Drainage Div., no. IR3, p. 257-264, illus., 1970.

The method of determining the displacement front of an interface between saline and fresh water to subsurface drains under ponded conditions, proposed by Luthin, et al. [1969], is extended to anisotropic soils. A computer program written in FORTRAN IV allows determination of the position of the displacement front at different times when point values of the stream and potential function are available. The results presented can be applied to any other system with the same value of the ratio k_h/k_r, which would be geometrically similar to the system considered herein. The results indicate that the distribution of flow at the surface improves with the value of the parameter k_h/k_r. This means that leaching in the region halfway between drains will be better for an anisotropic soil than for an isotropic one. — Authors' abstract

03817 **Osborne, Robert H.** Bedrock geology of the Madeira quadrangle, Hamilton and Clermont Counties, Ohio: Ohio Div. Geol. Survey Rept. Inv. 77, scale 1:24,000, text, 1970.

Resources of the Madeira quadrangle are ground water mainly from Illinoian deposits, and sand and gravel in terrace remnants of Wisconsin valley trains. — MCM

Ostenso, N. A. *See* Vogt, P. R. 03962

04234 **Ottaway, J. M.; Coker, D. T.; Davies, J. A.** A sensitive indirect method for the determination of titanium by atomic absorption spectrophotometry using an air-acetylene flame: Anal. Letters, v. 3, no. 7, p. 385-392, illus., 1970.

The enhancement of the atomic absorption signal of iron in a fuel-rich air-acetylene flame by small amounts of titanium makes possible the determination of titanium at concentrations of 0.01 to 10 ppm. The optimisation of working conditions for the determination of titanium by this indirect method are reported. — Authors' abstract

04260 **Ovenshine, A. T.; Webster, G. D.** Age and stratigraphy of the Heceta Limestone in northern Sea Otter Sound, southeastern Alaska, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C170-C174, illus., table, 1970.

The Heceta Limestone in the northern Sea Otter Sound area, Alaska, is more than 10,000 feet thick and contains two major zones of terrigenous clastic rocks. On the basis of sparse conodonts, graptolites, and brachiopods, it is late Early through Late Silurian in age. This new age assessment of the formation requires extension of the range in southeastern Alaska of the stromatoporoid *Amphipora* and the pelecypod *Pycinodesma*, both previously considered no older than Middle Devonian. — Authors' abstract

Padovani, E. Reeves. *See* Urban, J. B. 04356

04156 **Page, Virginia M.** "The problem of identifying the wood of Cretaceous . . . dicotyledons" forty-six years later [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 758-759, 1970.

Pakalns, G. V. *See* Swain, F. M. 04095

Pakiser, L. C. *See* Eaton, J. P. 03975

Pannella, Giorgio. *See* Rhoads, Donald C. 03885

04330 **Parizek, Richard P.; Siddiqui, Shamsul H.** Determining the sustained yields of wells in carbonate and fractured aquifers: Ground Water, v. 8, no. 5, p. 12-20, illus., tables, 1970.

Carbonate aquifers with highly developed anisotropic permeabilities and other fractured rocks under water-table conditions present complex hydrologic settings in which to predict the sustained yield of wells. In these settings yields are particularly responsive to the position of the water level and its relationship to producing zones. A well's total capacity may be due to openings encountered in drilling which are separated by nonproductive rock. A permeability profile, available drawdown and inclination of water-yielding openings must be defined for these wells. Available drawdown depends on inclination and position of significant openings exposed in the bore hole, on seasonal variations in the water-table position and on permeability. — *from* Authors' abstract

04015 **Parker, Raymond L.; Sharp, William N.** Mafic-ultramafic igneous rocks and associated carbonatites of the Gem Park Complex, Custer and Fremont Counties, Colorado: U.S. Geol. Survey Prof. Paper 649, 24 p., illus., tables, geol. map, 1970.

The Gem Park Complex, about 11 miles northwest of Westcliffe, Colo., is a small composite body related to the McClure Mountain alkalic complex a few miles to the northeast. The complex consists mostly of pyroxenite and gabbro with minor dikes and bodies of lamprophyre, syenite porphyry, and nepheline syenite pegmatite and abundant dikes and irregular-shaped bodies of carbonatite, all of Cambrian age. It also contains a mass of strongly fenitized rocks near its center. The whole complex lies discordantly in Precambrian gneissic terrane and is overlain in part by Tertiary volcanic rocks and Quaternary alluvium and colluvium. Some carbonatite dikes and fenitized rocks contain concentrations of niobium, rare-earth elements, thorium, phosphorus, and some other elements and vermiculite. — RLP

Pascoe, Ralph F. *See* Fishman, Marvin J. 04304

Pasley, Susan M. *See* Thompson, Geoffrey. 04084

04024 **Paterson, W. S. B.** Glaciation of the north-western part of the Canadian Arctic Archipelago [correction to 1969 paper]: Jour. Glaciology, v. 9, no. 56, p. 286, 1970.

A statement in a recent paper on The Meighan Ice Cap (Paterson, 1969, ibid., v. 8, no. 54, p. 341-352; Abs. North American Geology, June 1970), that islands in this area are marked "unglaciated" on the *Glacial map of Canada*, is true for the 1958 edition, but not for the 1968 edition on which only Banks Island and a small part of Melville Island are so marked. It is now believed that the remainder of the islands were covered by a large ice sheet during the last glaciation (Blake, W., Jr., 1970). — GDC

04126 **Patton, Clyde P.; Alexander, Charles S.; Kramer, Fritz L.** Physical geography: Belmont, Calif., Wadsworth Publishing Co., 408 p., illus., tables, 1970.

The aims of this textbook are to describe the major physical processes that shape the surface of the Earth and to present the distribution of the resulting surface features. Chapter headings are: location and maps; introduction to landforms; weathering and mass movement; gradation by streams; gradation by glaciers; gradation by wind; classification of landforms; plains; hills and mountains; continental margins and ocean

basins; oceans; heat balance of the Earth; temperature; pressure and winds; evaporation and condensation; air masses, fronts, and storms; precipitation; classification of climates; world distribution of climates; environment and distribution of vegetation; nature and formation of soils; and soil types and their distribution. A glossary and an index are appended. — MCM

Pedder, A. E. H. *See* Norford, B. S. 04100

04380 **Pelletier, B. R.; Godden, C. A.** A submersible electric coring drill for geological exploration of the shelf: Mining in Canada, August 1970, p. 34-40, illus., 1970.

This paper discusses the development of a drill designed specifically to function in all areas of the continental shelf to depths of 1,400 feet. Two factors considered in the design were ruggedness and portability. The drill can be handled easily in over-the-side operations, and can be transferred quickly from one ship to another or from shore station to ship. The drill can penetrate up to 13 feet of overburden and still retrieve bedrock core. Tests were conducted in quiet, protected waters, in conditions of moderate swell, and in the open Atlantic. Results are discussed and technical data on the drill and auxiliary equipment are presented. — GV

03945 **Penner, E.; Gillott, J. E.; Eden, W. J.** Investigation of heave in Billings shale by mineralogical and biogeochemical methods [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 333-338, illus., 1970.

A building founded on Billings Shale [in Ottawa, Ontario] has suffered nearly 4 in. (10 cm) of heave to its basement floor slab. The heaved zone was thought to be associated with a fault zone in the shale, near which the rock was fractured and contained extensive pyrite intrusions. Investigations have shown the heave to be due to the weathering of the pyrite in the presence of autotrophic bacteria. Factors creating a favorable environment for this complex weathering process are discussed. — Authors' abstract

04022 **Perhac, Ralph M.** Geology and mineral deposits of the Gallinas Mountains, Lincoln and Torrance Counties, New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 95, 51 p., illus., tables, geol. map, 1970.

Lower Permian sedimentary rocks grade upward from Abo arkoses through continental feldspathic sandstones of the Yebo Formation into beach or shallow-water marine Glorieta orthoquartzites. A southward facies change into lagoonal and marine beds indicates a northward-advancing Early Permian sea, reaching the Gallinas area by middle Permian time. Permian beds were uplifted, domed, and faulted by middle(?) Tertiary hypabyssal intrusives, primarily alkalic trachyte and rhyolite laccoliths, with minor contact metamorphism. Many iron and fluorite-copper-bastnaesite deposits are associated with the trachyte-iron as magnetite-hematite replacement lodes in Yeso carbonate beds, and fluorite-copper-bastnaesite as typical epithermal veins and breccia fillings in Yeso sandstones. The better iron is almost exhausted, and total reserves of fluorite, copper, and bastnaesite are small. — *from* Author's abstract

03807 **Persons, Benjamin S.** Laterite genesis, location, use: New York and London, Plenum Press, 103 p., illus., tables, 1970.

Laterite is found in hot, wet, forested areas, in not-so-wet grasslands, and in deserts which once were wet. This book is an attempt to consolidate information that will be useful for the geologist, soil scientist, and engineer and to clear up some of the semantic difficulties that have arisen over the years. Chapter headings are: genesis, geology of laterites, finding laterites, uses of laterite, construction techniques, and maintaining laterite. An excerpt from the U.S. Army Engineers "Soil mechanic textbook" on laterites and lateritic soils of Vietnam is appended. The bibliography contains 19 items. — MCM

04198 **Pessagno, Emile A., Jr.** The Rotaformidae, a new family of Upper Cretaceous Nassellariina (Radiolaria) from the Great Valley Sequence, California Coast Ranges: Bulls. Am. Paleontology, v. 58, no. 257, p. 7-32, illus., 1970.

The Rotaformidae, Pessagno, n.fam., are a bizarre group of dicyrtid Nassellariina with cartwheel-shaped tests and nine cephalic skeletal elements identical to those of the Neosciadiocapsidae Pessagno. It is postulated that the Neosciadiocapsidae gave rise to the Rotaformidae through (1) the rotation of the cephalis and upper thorax into the plane of the thoracic skirt and (2) the loss of the thoracic skirt and the subsequent development of a thoracic ring. Two new genera and seven new species of Rotaformidae are described from the Upper Cretaceous portion of the Great Valley Sequence, California Coast Ranges. — Author's abstract

Peterman, Zell E. *See* Hedge, Carl E. 03773

03826 **Peterman, Zell E.; Doe, Bruce R.; Prostka, Harold J.** Lead and strontium isotopes in rocks of the Absaroka volcanic field, Wyoming: Contr. Mineralogy and Petrology, v. 27, no. 2, p. 121-130, illus., tables, 1970.

The Absaroka volcanic field is comprised of predominant andesitic volcaniclastic rocks and less abundant potassium-rich mafic lavas (shoshonites and absarokites). Strontium and lead isotopic variations preclude a simple derivation from an isotopically uniform source: Sr-87/Sr-86, 0.7042 to 0.7090; Pb-206/Pb-204, 16.31 to 17.30; Pb-208/Pb-204, 36.82 to 37.64. We postulate that these rocks were derived from a lower crust or upper mantle which underwent a preferential loss of uranium relative to lead approximately 2800 ± 200 m.y. ago. Variations in lead and strontium isotopic compositions are thought to reflect small inhomogeneities in U/Pb and Rb/Sr ratios in the source. — Authors' abstract

Peters, John S. *See* Leisman, Gilbert A. 04389

04252 **Peterson, Donald L.; Oriel, Steven S.** Gravity anomalies in Cache Valley, Cache and Box Elder Counties, Utah, and Bannock and Franklin Counties, Idaho, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C114-C118, illus., 1970.

Interpretations of two-dimensional models prepared along four gravity profiles across Cache Valley indicate approximate thickness of water-bearing Cenozoic strata and gross structure of underlying older bedrock. Thickest Cenozoic strata, 7,000 and 8,000 feet, occur in two fault-bounded troughs near the Idaho-Utah State line separated by a basement high extending from Bannock Range southward through Bergeson Hill to Little Mtn. The eastern trough is bounded on the east by a buried block of Paleozoic rock extending southwestward from Mt. Smart. Farther north, a block of Precambrian rock extending southward beneath thin Cenozoic fill for at least 4 mi, is bounded on the east by a fault. Belts of high and low gravity values in Idaho along the west edge of the Bear River Range coincide with belts of pre-Cenozoic and Salt Lake strata. — *from* Authors' abstract

Peterson, Orin. *See* Michelson, R. W. 04435

03907 **Petocz, Ronald G.** Biostratigraphy and Lower Permian Fusulinidae of the Upper Delta River area, east-central Alaska Range: Geol. Soc. America Spec. Paper 130, 94 p., illus., tables, 1970.

A Lower Permian fusulinid fauna was found in rocks of Mankomen age within a fault block in the Upper Delta River area, east-central Alaska Range. Three members of the Mankomen Formation recognized and described are: a lower Tuffaceous Sandstone Member, Alternating Limestone-Shale Member, and Limestone Member. Eighteen species of fusulinids belonging to three genera [*Pseudofusulinella*, *Eoparafusulina*, *Schwagerina*] are described from the Alternating Limestone-Shale Member and Limestone Member. This fauna is divided into six assemblage zones which collectively indicate a Lower Permian age from late Asselian to middle Artinskian, when compared to Permian sections in the western Urals. Fusulinids from the Alaska Range belong to a Boreal faunal realm including seas of the Alaskan, Cordilleran, Franklinian, and Uralian geosynclines. Correlations are suggested between the Alaska Range section and other northern areas of the world. — *from* Author's abstract

04325 **Pettijohn, F. J.** Geology and magnetic data for northern Crystal Falls area, Michigan: Michigan Geol. Survey Rept. Inv. 8, 23 p., illus., tables, geol. maps, 1970.

Folded and upturned strata of the Animikie Series (oldest to youngest — Dunn Creek Slate, Riverton Iron-formation, Hiawatha Graywacke, Stambaugh Formation, and Fortune Lakes Slate) occur as belts trending roughly east, intruded by minor pegmatitic quartz veins and small bodies of metadiabase and metagabbro. Structurally they lie along the northeastern apex of the Iron River-Crystal Falls synclinorium and mainly within the northern part of a large complex southwest-plunging syncline, the southern part of which has been cut off by major east-trending right lateral faults. Most of the larger ore bodies are related to synclines and confined to the lower part of the Riverton Iron-formation. Outcrops, mine workings, exploration information, magnetic data, and test pits are shown on detailed geologic maps. Brief histories and descriptions of mines and explorations are given. Production, 1882-1968, was almost 21 million tons of iron ore. — *from* Author's abstract

03860 **Philley, John C.** Field trip No. 4, Paleozoic section on east flank of Cincinnati Arch along Interstate 64, Lexington to Olive Hill, Kentucky — Pt. 2, Valley of Licking River eastward to Olive Hill interchange, *in* Guidebook for field trips — Geol. Soc. America, Southeastern Sec., 18th Ann. Mtg., Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, p. 56-70, illus., 1970.

Mississippian sections are examined at five stops in this area. Well exposed at Bratton Branch is the basal Farmers Member of the Borden Formation, and underlying shales; substratal lineations and other features suggest turbidity currents moved the siltstone elements from east to west. At Haney Branch is shown subtle gradational boundary between the sparsely fossiliferous Nancy and Cowbell Members. Three hillside cuts at Perry Branch expose, west to east, upper Borden units, Newman Limestone, and Lower Pennsylvanian rocks, as described. At Smith Run, contorted beds in the Newman Limestone and shale in solution channels of the Borden's Renfro Member, repeated in several roadcuts, mark the Mississippian-Pennsylvanian unconformity. At Armstrong Hill the Newman has three units comparable to those in the Perry Branch section, but important differences are revealed and a tidal-facies relation suggested. — GDC

04229 **Phillips, H. Boyd; McDonald, Harris R.** Analog of ground water in east-central New Mexico — Closure [to discussion of paper 6435, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Irrigation and Drainage Div., no. IR3, p. 345-346, 1970.

Paper 6435 (ibid., v. 95, no. IR1, p. 27-42, 1969) was cited in Abs. North American Geology, September 1969, and discussion by R. A. Longenbaugh and G. L. Guymon (ibid., no. IR4, p. 639-640, 1969), in May 1970.

04195 **Phillips, Tom L.; Rosso, Samuel W.** Spores of *Botryopteris globosa* and *Botryopteris americana* from the Pennsylvanian: Am. Jour. Botany, v. 57, no. 5, p. 543-551, illus., tables, 1970.

A study of spores from fertile pinnae of *Botryopteris* from Middle and Upper Pennsylvanian coal balls from Iowa, Illinois, and Kansas indicates two distinct species, *Botryopteris globosa* and *B. americana*. The organization and attachments of fertile pinnae and the sporangial morphology and dimorphism are identical in the two species. Data are given on fertile pinnae dimensions, attachments of six fertile pinnae, spore counts from individual sporangia, and spore morphology. The ornamentation of *B. americana* spores is verrucate to rugulate with verrucae fusing to a variable extent to form bars and convolute ridges; *B. globosa* spores are vermiculate or fossulate to densely rugulate with scattered verrucae. Comparisons are made with *B. forensis* and a reinterpretation of the spore forms of *B. forensis* is suggested. — Authors' abstract

03979 **Phinney, Robert A.** Reflection of acoustic waves from a continuously varying interfacial region: Rev. Geophysics and Space Physics, v. 8, no. 3, p. 517-532, illus., 1970.

Reflection-transmission problems for plane waves can be analytically solved in a restricted number of special cases for which asymptotic connection formulas exist. The technique is demonstrated for the case of a parabolic barrier. A method of Epstein's, which makes use of the properties of hypergeometric functions, can be used to obtain solutions for a variety of transitional structures. This method is taken from the field of ionospheric radio-wave propagation and is adapted to the acoustic problem without neglect of the density gradient. The solution for a monotonic transitional zone is obtained and the behavior of the subcritical reflection is discussed, with reference to the inner core reflection as an example. — Author's abstract

03821 **Phinney, William C.** Chemical relations between Keweenawan lavas and the Duluth complex, Minnesota: Geol. Soc. America Bull., v. 81, no. 8, p. 2487-2495, illus., tables, 1970.

Keweenawan basalt analyses having high Al_2O_3 and CaO contents fall on a linear trend on a CaO versus Al_2O_3 plot. Using plagioclase and augite compositions from the gabbroic anorthosites of the Duluth complex, it is possible to explain the basalt trend by separation of gabbroic anorthosites from a melt rich in Al_2O_3 and CaO. Calculations of the amount of solidification indicate that as much as 60 percent solid material separated from other gabbroic rock types crystallized from the melt. Trends of MgO, FeO, and K_2O suggest that another fractionation may have preceded the separation of gabbroic anorthosite. An important conclusion from these arguments is that the multiple intrusions of the Duluth complex represent the crystalline material in magma chambers from which the Keweenawan flows of Lake Superior's north shore were derived. — Author's abstract

04401 **Picard, M. Dane; High, Lee R., Jr.** Sedimentology of oil-impregnated, lacustrine and fluvial sandstone, P. R. Spring area, southeast Uinta Basin, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 33, 32 p., illus., tables, 1970.

In oil-impregnated intervals within the Garden Gulch and Parachute Members of the Green River Formation, paleocurrent measurements from crossbedding and ripple marks are related to paleoslope and orientation of shorelines and sandstone-body trends in the lacustrine and fluvial setting of the upper Wasatch and lower Green River Formations. Most fluvial paleocurrent patterns indicate that meandering streams flowed north into Lake Uinta, at low gradients; many of the fluvial sandstone bodies trend north-south, with north-inclined foreset laminae. Southerly lacustrine paleocurrent patterns indicate onshore lake currents; shorelines probably trended mostly northeast, but to the northeast were oriented northwest-southeast. Paleocurrent patterns of fluvial and lacustrine sandstones are both unimodal, but, by paleocurrent orientations, the two environments can be differentiated. — GDC

04352 **Pickering, D. J.** Anisotropic elastic parameters for soil [with French abs.]: Géotechnique, v. 20, no. 3, p. 271-276, illus., 1970.

The concept of soil as an anisotropic elastic material is considered and the theoretical bounding values of the relevant elastic parameters are described. The bounding values of the parameters are represented in three-dimensional space. Within the space any given material is represented by a point and points in certain regions represent particular types of material. The requirements for infinite bulk modulus, for uncoupled volumetric and distortional phenomena and for dilatant soil are represented within the bounds of possible materials. — Author's abstract

04243 **Pilkey, Orrin H.; Bornhold, Brian D.** Gold distribution on the Carolina continental margin, a preliminary report, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C30-C34, illus., tables, 1970.

Gold in heavy-mineral fractions of sediments from the Carolina continental margin is restricted to the general vicinity of Cape Lookout and northward. Most of the observed concentrations of gold are very low (0.7 to 7.0 ppb) and at or near the limits of analytical detection. — Authors' abstract

04281 **Pinckney, Darrell M.; Haffty, Joseph** Content of zinc and copper in some fluid inclusions from the Cave-in-Rock district, southern Illinois: Econ. Geology, v. 65, no. 4, p. 451-458, illus., table, 1970.

Zinc, copper, and chlorine analyses were made of fluids in crystals of fluorite, quartz, and barite to determine amounts of zinc and copper and to see if amounts of these metals change with time of deposition and with location. Crystals are from hydrothermal deposits characterized by fluorite, sphalerite, galena, and minor chalcopyrite. Ranges of concentration in inclusions are: zinc, 10-1,040 ppm; copper, undetectable to 350 ppm; chlorine, 2,500-152,000 ppm. Variations in base metal and chlorine content were found relative to periods of deposition of sphalerite. In one ore body the amount of base metals and chlorine was greater in the interior than at the edges of the body. Good correlation exists between zinc and chlorine for the sulfide-ore solutions as samples with high zinc concentrations also have correspondingly high chlorine concentrations. — *from* Authors' abstract

Pirone, A. J. *See* Vastola, F. J. 04093

03815 **Pitkin, James A.** Natural gamma radioactivity map of the Fort Worth-Dallas area, Texas: U.S. Geol. Survey Geophys. Inv. Map GP-696, scale 1:250,000, text, 1970.

Total range of aeroradioactivity levels in the Fort Worth-Dallas area is 250-750 cps, correlatable generally with bedrock geology. Significant changes in level of aeroradioactivity at boundaries range from 50-200 cps. Outcropping Pennsylvanian rocks can be considered as an integral aeroradioactivity unit, with levels ranging from 300-750 cps. Levels of 700-750 in Jack County, among the highest in the area, probably reflect a greater abundance of shale. Rocks of the Cretaceous system display a wide range of levels; a high of 400-600 cps was found in Quaternary alluvium. — MCM

Podolsky, T. *See* Naldrett, A. J. 04413

04430 **Pohl, E. R.** Upper Mississippian deposits of south-central Kentucky, a project report: Kentucky Acad. Sci. Trans., v. 31, nos. 1-2, p. 1-15, illus., 1970.

The author describes the stratigraphy of the Upper Mississippian deposits in an area in south-central Kentucky, from the base of the Ullin Formation upward. He proposes a new stratigraphic unit, the Horse Cave Member of the St. Louis Formation, and gives its identifying criteria. The foraminifera *Eoendothyranopsis* is identified with the St. Louis Formation and the extinction of the algal genus *Koninckopora*, locally, occurs toward the end of the unit. — *from* Author's abstract

Polta, H. J. *See* Michelson, R. W. 04435

Ponsetto, Louis R. *See* Noger, M. C. 03856

Porath, H. *See* Gough, D. L. 04445

Post, B. *See* Banks, E. 04367

04040 **Potosky, Robert A.; Kopp, Otto C.** Application of cathodoluminescence to petrographic studies: Compass, v. 47, no. 2, p. 63-69, illus., 1970.

Minerals containing activator ions luminesce in an electron beam and reveal textures not visible to the eye using ordinary light. Textures such as crystal zoning, cavity filling, fracture filling, and replacement were observed in several specimens using this technique. Any specimen that shows weak luminescence should be photographed since time exposures enhance differences not apparent visually and photographic film may record wavelengths to which the eye is not sensitive. — Authors' abstract

03771 **Powell, J. L.; Bell, Keith.** Strontium isotopic studies of alkalic rocks, localities from Australia, Spain, and the western United States: Contr. Mineralogy and Petrology, v. 27, no. 1, p. 1-10, illus., tables, 1970.

Initial Sr-87/Sr-86 ratio ranges in 83 samples of eight suites of alkalic and ultrabasic rocks and numbers of samples (in parentheses) are: West Kimberley, Australia (8) 0.7125-0.7215; Jumilla, Spain (6) 0.7136-0.7158; Bearpaw Mountains, Montana (9) 0.7062-0.7086; Highwood Mountains, Montana (10) 0.7072-0.7087; Hopi Buttes, Arizona (8) 0.7038-0.7094; Leucite Hills, Wyoming (17) 0.7055-0.7070; Montana diatremes (13) 0.7034-0.7073; Navajo Province, Arizona and New Mexico (12) 0.7052-0.7099. The initial Sr-87/Sr-86 ratios of the West Kimberley and Jumilla rocks are the highest yet found in strontium-rich basic rocks. Some of the individual specimens from West Kimberley have initial ratios as high as some estimates of the present Sr-87/Sr-87 ratio of average crustal material. This is interpreted to mean that the West Kimberley and Jumilla rocks contain substantial amounts of radiogenic strontium and possibly other elements, from a crustal source. — *from* Authors' abstract

03949 **Powell, Richard L.** Base level, lithologic and climatic controls of karst groundwater zones in south-central Indiana: Indiana Acad. Sci. Proc. 1969, v. 79, p. 281-291, illus., table, 1970.

Ground-water movement in the carbonate bedrock has been within a karst groundwater zone that occupies the lower part of the vadose zone above permanent saturation or local base level and is characterized by a highly fluctuating water table. Variations of precipitation, and local relief above base level, control the vertical range of the water table and subsequent solution within the karst zone during the time corresponding to each subaerial erosion level. Variations in carbonate solubility, thickness of beds, and intensity of jointing determine texture and shape of conduits, and the volume of water transmitted through the karst ground-water zone and its acidity, determine size. Shales and silty units, and sandstone, dolomite, and jointed limestone may form perched water bodies. The first two may be breached by joints or erosion, and the last three will release water to subjacent less permeable limestone. — *from* Author's abstract

04365 **Prakash, Uttam; Boureau, Édouard.** Sur une monocotylédone herbacée fossile à structure conservée des basaltes de Columbia, dans le Miocène de Vantage, central Washington, U.S.A. [On a fossil herbaceous monocotyledon from structures preserved in Columbia basalts in the Miocene at Vantage, central Washington, U.S.A.], *in* Soc. Savantes Cong. Natl., 92d, Strasbourg et Colmar, 1967, Comptes Rendus, Sec. Sci., V. 3: Paris, Bibliothèque Natl., p. 93-107, illus., 1970.

Typhaephyllum scammonii, a new organ genus and species of monocotyledonous angiosperm referable to the family Typhaceae (cattails) is described from the late Miocene Columbia River Basalt near Vantage, Kittitas County, Wash. The specimen is a 3-cm-long portion of two concentric leaves with internal structure well preserved — a rare condition in fossil herbaceous monocots. Aerenchymatous tissue is separated by radial partitions in transverse section, by diaphragms in longitudinal section; the fundamental parenchymatous tissue encloses many fibrous and fibrovascular bundles. The new specimen is compared with living species, and with other fossil occurrences of Typhaceae; it closely resembles the living *Typha angustifolia* but, in absence of floral elements, is not referred to the natural genus. — VMJ

Prasertwitayakij, A. *See* Buravas, S. 04368

Pratt, Richard M. *See* Schlee, John. 04030

04060 **Pravdić, V.** Surface charge characterization of sea sediments: Limnology and Oceanography, v. 15, no. 2, p. 230-233, illus., tables, 1970.

Sea sediments of various origin have been studied with respect to their electrokinetic potential in sea water of varying salinity. All the sediments tested are negatively charged in sea water and most of them are positively charged in fresh water. Charge reversal occurs between 2 and 6 per thousand salinity. This could possibly influence the deposition of certain ions and minerals at, or near, river estuaries. — Author's abstract

03901 **Price, Larry W.** Up-heaved blocks, a curious feature of instability in the tundra: Assoc. Am. Geographers Proc., v. 2, p. 106-110, illus., 1970.

Up-heaved blocks occurring in unconsolidated material on vegetated slopes were investigated in the Ruby Mts., Yukon Territory. They resemble frost-thrust blocks occurring on level, poorly vegetated bedrock areas, are one to three feet high, and show evidence of recent activity, with freshly overturned turf around the bases of some. Measurements reveal an annual movement of only one or two inches. Origin of these features is suggested as being a result of several processes. Diurnal freeze and thaw is important for two or three weeks in the spring. The annual freeze in the fall contributes about one-fourth inch to the upheaval of the blocks, and solifluction is important during the summer. The size and shape of blocks, as well as local site conditions, govern the occurrence of these features which are striking evidence of the instability that characterizes the tundra. — *from* Author's abstract

04433 **Pride, R. W.** Estimated water use in Florida, 1965: Florida Bur. Geology Map Ser., no. 36, scale about 1 in. to 30 mi., text, 1970.

Estimates of water use in Florida were made by county, by source of water, and by principal use. The map shows estimated water withdrawal by categories of public supply, self-supplied industrial, irrigation, and thermoelectric power generation, for fresh surface water, fresh ground water, and saline water. — MCM

Prostka, Harold J. *See* Peterman, Zell E. 03826

03930 **Prusok, Rudi.** Ice as stream table bedrock: Jour. Geol. Education, v. 18, no. 4, p. 170, 1970.

To simulate a stream eroding bedrock or forming entrenched meanders, the use of ice as bedrock is inexpensive and suitable. The action of water flowing over ice is mostly melting rather than abrasion, and the melting rate can be controlled through water temperature. Preparation and operation of such a stream table is described. — ESL

03869 **Pugh, Wally.** Fossil cache on the Eel: Gems and Minerals, no. 397, p. 28, 44-46, illus., 1970.

One of the greatest points of interest to the rockhound in Humboldt County, Calif., is the fossil-filled bluff formed by the arc of the Eel River between Scotia and Rio Dell. Constant weathering and erosion renew the supply of debris at the base. The shells show that in lower Pliocene time this part of the county was an ocean basin, and the climate was cooler. More than 85 species of megafossils, mostly gastropods and pelecypods, and an additional 45 species of foraminifera, have been collected. — ESL

04324 **Pyrih, Roman Z.; Bisque, Ramon E.** Determination of trace mercury in soil and rock media — A reply [to 1970 discussion by W. T. Meyer and D. S. Evans of 1969 paper]: Econ. Geology, v. 65, no. 3, p. 358-359, tables, 1970.

The paper under discussion (ibid., v. 64, p. 825-828, 1969) was abstracted in Abs. North American Geology, April 1970. — VSN

Qamar, A. *See* Bolt, Bruce A. 04115

03929 **Qutub, Musa Yacub.** The status of earth science in Illinois: Jour. Geol. Education, v. 18, no. 4, p. 163-165, tables, 1970.

At present 44,729 students are enrolled in earth science in Illinois. Information for this study was obtained from two questionnaries, one sent to 46 colleges in the state, the other to superintendents of 1,352 public school districts. More than half the schools teaching earth science present it in the eighth grade; 26,792 seventh and eighth grade pupils are enrolled. There are at least 870 earth science teachers in the state, and 63 more are planning to introduce it. Tables give the background of the

current earth-science teachers, and indicate program preferences with regard to future in-service training and subject matter preferences. Three methods of teaching in orienting current teachers to earth science are recommended. — ESL

04308 **Radtke, Arthur S.; Scheiner, Bernard J.** Studies of hydrothermal gold deposition — [Pt.] 1, Carlin gold deposit, Nevada, the role of carbonaceous materials in gold deposition: Econ. Geology, v. 65, no. 2, p. 87-102, illus., tables, 1970.

Studies of carbonate host rocks and gold ores of Carlin mine indicate that gold, quartz, barite, pyrite, and other sulfides were introduced into the Roberts Mts. Formation by acid hydrothermal solutions. Laboratory investigations show that the rocks contain: an activated carbon component capable of adsorbing gold chloride or cyanide complexes from solution, a mixture of high-molecular-weight hydrocarbons, and an organic acid with functional groups capable of interacting with gold complexes to form gold organic compounds. Subsequent oxidation of these compounds destroys the organic component and leads to formation of metallic gold. Relative amounts and types of carbonaceous materials are of principal importance in determining chemical state and amount of gold deposited in limestone. Most gold ores are in the Silurian Roberts Mts. Formation, but the Devonian Popovich and Ordovician Vinini Formations are also favorable for replacement and deposition. — *from* Authors' abstract

Ragland, Paul C. *See* Dobbins, David A. 03956

Raleigh, C. B. *See* Healy, J. H. 03974

04013 **Ralston, Dale R.; Chapman, Sheri L.** Ground-water resource of southern Ada and western Elmore Counties, Idaho: Idaho Dept. Reclamation Water Inf. Bull. 15, 52 p., illus., tables, 1970.

Four hydrogeologic units are important as aquifers in southern Ada and western Elmore Counties: lower sand and gravel, basalt, upper sand and gravel, and sand-silt; greatest yields to wells are from the sand and gravel and basalt units. Well development, concentrated in the northwestern portion, is the basis for delineation of two subareas: (1) Kuna, where wells are less than 1,000 feet deep, derive water from any units except the sand-silt, and yield > 2,000 gpm; and (2) Orchard, where wells range from 20-1,620 feet deep, derive water from the basalt or sand-silt units, and yield a maximum of 750 gpm. Sodium bicarbonate and calcium bicarbonate are predominant water types; most water is suitable for irrigation and domestic use. — *from* Authors' abstract

04070 **Rama Murthy, V.; Hall, H. T.** The chemical composition of the Earth's core — Possibility of sulphur in the core: Physics Earth and Planetary Interiors, v. 2, no. 4, p. 276-282, illus., tables, 1970.

Abundances of several volatile trace-elements show that sulfur is depleted in the Earth's mantle and crust by almost two orders of magnitude more than rare-gases, halogens, and water. It is suggested that the missing sulfur was segregated into the core as part of the lowest melting components in the Fe-S-O system. In most thermal history models of the Earth, temperature of the outermost 100-200 km never exceeds the melting point of the Fe-FeS eutectic, leading to retention of some metallic Fe-Ni and iron sulfide in upper mantle, which oxidized and mixed with the lower depleted mantle. An important consequence of sulfur as a major element in the core is that the composition of no meteorite type satisfactorily resembles the major element composition of an Earth with a Fe-Ni-S core and mantle similar to pyrolite. — *from* Authors' abstract

Ramsay, J. N. *See* Douglas, A. G. 04193

Randall, M. J. *See* Knopoff, L. 03964

03965 **Randall, M. J.; Knopoff, L.** The mechanism at the focus of deep earthquakes: Jour. Geophys. Research, v. 75, no. 26, p. 4965-4976, illus., tables, 1970.

Amplitudes of long-period pulses are used in an analysis of several intermediate and deep-focus earthquakes to determine whether the mechanism is of the double-couple or compensated linear vector dipole type. For most of the shocks, the double-couple model dominates the linear dipole model, but not overwhelmingly so. — Authors' abstract

04057 **Rankin, William E.; Lavin, Peter M.** Analysis of a reconnaissance gravity survey for drift-filled valleys in the Mercer quadrangle, Pennsylvania: Jour. Hydrology, v. 10, no. 4, p. 418-435, illus., 1970.

Effectiveness of a standard polynomial trend removal technique and two-dimensional wavenumber filtering in isolating gravity anomalies due to buried preglacial drainage systems was evaluated for an area in northwestern Pennsylvania, where gravity surveying is a useful reconnaissance technique. Both analytical methods isolated anomalies due to valleys of major hydrological interest, provided similar useful information on valley trends, and gave reasonably accurate width estimates. Accurate depth estimates could not be inferred, although large anomalies generally coincided with thicker drift accumulations. With station spacing of about 0.75 mi, valleys sought must have drift accumulations in excess of 75 feet and widths of at least one mile to be adequately resolved. The two-dimensional filtering method seems to offer the most complete information. — *from* Authors' abstract

04064 **Rauch, Henry W.; White, William B.** Lithologic controls on the development of solution porosity in carbonate aquifers: Water Resources Research, v. 6, no. 4, p. 1175-1192, illus., tables, 1970.

Movement of ground water in maturely karsted limestone aquifers is commonly through solution conduits of considerable size. The object of this study was to determine the lithologic controls on the distribution of conduits within a heterogeneous sequence of carbonate rocks. The volume of all accessible caves more than 100 feet in length in the Nittany Valley area of central Pennsylvania was measured. Most caves are entirely within limestones; cave development in dolomite is extremely rare. Within the limestone sequence the bulk of the cave volume is concentrated in a few members. Chemical and petrographic analyses of the carbonate rocks were associated with cave volume by bar graphs and components analyses. The more cavernous limestones seem to be those with low amounts of dolomite, clay, and other impurities, and a high micrite grain fraction. Coarse limestones and dolomites are less cavernous. — Authors' abstract

Ray, B. W. *See* Bushue, L. J. 03937

Reasenberg, Paul. *See* Aki, Keiiti. 04337

04268 **Rebagay, T. V.; Ehmann, W. D.** Simultaneous determination of zirconium and hafnium in standard rocks by neutron activation analysis: Jour. Radioanal. Chemistry, v. 5, no. 1, p. 51-60, illus., tables, 1970.

A sensitive analytical technique has been developed to determine zirconium and hafnium at the 1 ppm and 0.01 ppm levels, respectively, in natural silicate matrices. The technique is based on the use of a Ge(Li) detector for high-resolution γ-ray spectrometry following irradiation with thermal neutrons. Simultaneous separation of both elements is achieved by addition of only zirconium carrier and use of a strongly basic anion-exchange resin. Hafnium was shown to follow zirconium throughout the chemical procedures. The chemical yield of the separation procedure was determined for each sample by use of an automated fast-neutron activation analysis system, which obviated the need to convert the separated zirconium to a conventional gravimetric weighing form. The method has been applied to the analysis of a variety of standard rocks and related natural materials. — Authors' abstract

04258 **Reed, John C., Jr.; Marvin, Richard F.; Mangum, John H.** K-Ar ages of lamprophyre dikes near Great Falls, Maryland-Virginia, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C145-C149, illus., tables, 1970.

Biotite from small undeformed dikes of biotite lamprophyre cutting the complexly folded metasedimentary rocks of the Wissahickon Formation at Great Falls, Maryland-Virginia, has K-Ar ages of about 360 million years. This suggests that the age of dike emplacement is no later than Middle Devonian and is consistent with the interpretation that major deformation and regional metamorphism in this part of the Piedmont had ended by Late Ordovician or Early Silurian. The lamprophyre dikes are cut by a fault, one of a family of faults that controlled gold mineralization in the Great Falls area, indicating that the mineralization is of post-Middle Devonian age. — Authors' abstract

04244 **Reimnitz, Erk; vonHuene, Roland; Wright, F. F.** Detrital gold and sediments in Nuka Bay, Alaska, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C35-C42, illus., table, 1970.

A marine geological investigation of Nuka Bay was conducted to learn more about possible occurrence of gold placers on Alaskan shelves and about fiord sedimentation. Sediment types, distribution, and thicknesses were outlined by examining 28 bottom samples and seismic reflection profiles. In the bay, Holocene marine sediment occurs in thicknesses of nearly 300 m in individual depressions. Sand and gravel are deposited in deltas and in recent moraines; relict sand and gravel are exposed on the adjacent open shelf. Numerous streams feeding Nuka Bay carry gold, yet bottom mud in the bay contains no gold. A small amount was detected in two samples of relict gravel and in unsorted coarse materials dumped into the fiord head by a glacier. Gold apparently moves with the coarse fraction of sediment supply and is retained in deltas and moraines where there is little chance of finding an economic concentration. —*from* Authors' abstract

04116 **Renault, Jacques; Bonem, Rena Mae; Riese, Ronald.** Computerization of the New Mexico Bureau of Mines Mineralogical Museum: New Mexico Bur. Mines and Mineral Resources Circ. 111, 49 p., illus., 1970.

The computerization of on-file data for the collection of 6,900 mineral specimens in the museum of the New Mexico Bureau of Mines is essentially completed. X-ray diffraction patterns and emission spectrograms are being prepared and will be added to computer storage. The goal was to be able to search in six categories: mineral assemblages, geographic location, storage or display location, donor or source, comments, and extra data. Programs were written in FORTRAN IV for the IBM 360/44 computer, which has a 32K core storage. Types of programs constituting the system are: those used to store records of all specimens, those used to provide and maintain catalogs, and those used for searching. Appendixes give program descriptions, flow charts, program listings, and formats of data cards. — ESL

04008 **Render, F. W.** Geohydrology of the metropolitan Winnipeg area as related to groundwater supply and construction [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 243-274, illus., 1970.

Winnipeg's major aquifer is the fractured upper 50 to 100 feet of Paleozoic carbonate rocks; two minor water zones are in mantling glacial till and Agassiz lake beds. In the northeast, in Birds Hill sand and gravel deposits of 60 sq mi, is a partially confined glaciofluvial aquifer. Karstic bedrock surface slopes toward the Red River and controls ground-water flow. Pumping of the Upper Carbonate aquifer, with transmissibility of 2,000 to 200,000 gal per ft/day, was curtailed in 1919 after completion of an aqueduct from Lake of the Woods. Piezometric surface elevations, 800 to 1,500 feet in recharge areas, are below 700 feet in the major drawdown cone. Hydrostatic pressure in and natural discharge from the Upper Carbonate have affected deep excavations, particularly excessive seepage inflows in the Red River Floodway. — GDC

04292 **Rendu, Jean-Michel.** Some applications of geostatistics to decision making in exploration [abs.]: Canadian Mining and Metall. Bull., v. 63, no. 696, p. 445, 1970.

03919 **Rex, David C.; Dodson, Martin H.** Improved resolution and precision of argon analysis using an MS 10 mass spectrometer, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 275-280, illus., table, 1970.

The resolution and peak shape obtained on argon using an A.E.I. MS 10 mass spectrometer are improved by using a 4.1 kG permanent magnet in place of the standard 1.8 kG magnet. The precision obtained with a digital out-put and peak switching system is considered with special reference to young K-Ar ages. — Authors' abstract

04232 **Rey, P.; Wakita, H.; Schmitt, R. A.** Radiochemical neutron activation analysis of indium, cadmium, yttrium and the 14 rare earth elements in rocks [with French and German abs.]: Anal. Chim. Acta, v. 51, no. 2, p. 163-178, illus., tables, 1970.

The elements were simultaneously separated in U.S. Geological Survey standard rocks, BCR-1 (basalt), G-2 (granite), and DTS-1 (dunite), and determined by γ-spectrometry with a 3×3 in NaI(Tl) well crystal and associated electronics. This method enabled accurate determination of all the rare earths within a short time compared with instrumental methods. Results for indium, cadmium, and the rare earths are in excellent agreement with literature values. Indium and cadmium show decreasing concentrations in the sequence BCR-1/G-2/DTS-1. Relative to the rare earth distribution pattern in chondritic meteorites, the rare earth pattern observed in BCR-1 and G-2 are similar to other basalts and granites; however, that in DTS-1 is V-shaped with a minimum at terbium and is similar to rare earth patterns observed in olivine minerals. — *from* Authors' abstract

03885 **Rhoads, Donald C.; Pannella, Giorgio.** The use of molluscan shell growth patterns in ecology and paleoecology: Lethaia, v. 3, no. 2, p. 143-161, illus., tables, 1970.

The influence of substratum, depth of water, turbidity, and temperature on daily growth patterns has been studied by transplanting juvenile *Mercenaria mercenaria* from the laboratory to intertidal and subtidal environments. Study of seasonal growth variations in a population of *Gemma gemma* from an intertidal flat on Long Island Sound shows that shell growth patterns may be used to determine the season of death and age at death; deep-water species (e.g., *Nucula cancellata*, *Calyptogena ponderosa*, *Malletia* sp.) exhibit growth increments that are more uniform in thickness and less sharply defined than in shallow-water species. Paleoecologic applications are tabulated, and further discussed, for each physiologic and environmental event known to be recorded in molluscan growth patterns. — *from* Authors' abstract

03799 **Richart, F. E.; Hall, J. R., Jr.; Woods, R. D.** Vibrations of soils and foundations: Englewood Cliffs, N.J., Prentice-Hall, 414 p., illus., tables, 1970.

04249 **Richter, Donald H.** A corundum occurrence in the eastern Alaska Range, Alaska, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C98-C102, illus., tables, 1970.

Crystals of gray corundum, as much as 8 cm long, occur in alkali pegmatite dikes in the Mentasta Mountains of the eastern Alaska Range. The pegmatite dikes cut a syenite-monzonite gneiss that is part of a large metaigneous complex consisting principally of diorite gneiss. Field relations and K-Ar dates suggest that the rocks of the complex were syntectonically emplaced during late Permian or Triassic time. The pegmatite dikes are composed almost entirely of orthoclase, orthoclase microperthite, and soda feldspar; biotite and hornblende are minor constituents. Corundum has only been recognized in three dikes and where present is generally associated with muscovite. Asteriated stones have been cut from the larger corundum crystals, but the poor quality and scarcity of the crystals preclude an economic gem industry. — Author's abstract

Riese, Ronald. *See* Renault, Jacques. 04116

Rincón Orta, Cesar. *See* Cserna, Zoltan de. 04180

04017 **Roberts, John L.** Using professional equipment in the beginning geology course: Jour. Geol. Education, v. 18, no. 4, p. 169-170, 1970.

Bradford Junior College (Mass.) for girls, gives one geology course, a two-semester elective, physical and historical geology. A direct-reading spectroscope has been acquired and is used mainly in connection with the laboratory on minerals to aid in

identification. The first time a student uses the spectrometer, the professor leads her through step by step, and she soon learns to operate it with a minimum of supervision. It also helps identify rocks picked up on field trips. Such professional equipment is of significant value in bringing vitality, interest, and real understanding to the course. — ESL

04085 **Roberts, John M.** The wandering sands: Américas, v. 22, no. 8, p. 9-14, illus., 1970.

Movement of dunes sand has been taking place around the Great Lakes since long before man set foot in the area. Basins of the lakes were gouged out by glaciers, and sand was derived from erosion of glacial material around the edges. Most sand grains in the area are quartz, and size ranges from one two-hundredth to one-fiftieth of an inch. Some sand is left high on the beach and blown inland to form dunes, other grains are carried out by undertow. Along the Lake Michigan shore, prevailing westerly winds give rise to dunes parallel with the shore. Wherever something checks the free movement of the wind, dunes will form, and advance before the wind engulfing anything in their paths. American dunes are pockmarked with small lakes and swampland, while those of the Sahara are interspersed with areas of bare rocks. — ESL

04397 **Robertson, George M.** The oral region of ostracoderms and placoderms, possible phylogenetic significance: Am. Jour. Sci., v. 269, no. 1, p. 39-64, 1970; erratum, ibid., no. 3, p. 320, 1970.

A study of the skeleton of the oral region in fossil Agnatha and Placodermi shows a variety of arrangement of bony elements associated with the mouth region. The placoderm "jaws" represent part of the postoral skeletal radiation found among Ostracodermi. Acanthodii should probably be removed from the Placodermi. They may be an annectant group between Placoderms and other gnathostomes. It is suggested that Ostracodermi and Placodermi, at least the Antiarchi and Arthrodira, be placed in a super-class Prognathostomata; Acanthodii being placed with the other gnathostomes as Eugnathostomata, which would be defined as vertebrates having a lower jaw based on Meckel's cartilage. — Author's abstract

04065 **Robinson, E.; Lamb, James L.** Preliminary palaeomagnetic data from the Plio-Pleistocene of Jamaica: Nature, v. 227, no. 5264, p. 1236-1237, illus., 1970.

Fourteen oriented samples, showing no post-depositional alteration effects, were collected in the Plio-Pleistocene of the Coastal Group on Jamaica. Comparison of geomagnetic events with the planktonic foraminiferal succession permits comparison with previously described geomagnetic-planktonic datums. The evolutionary appearance of *Sphaeroidinella dehiscens* occurs near the Mammoth event at about 3.0 m.y. ago, the extinction horizon of *Globoquadrina altispira* near the Kaena event at about 2.8 m.y. ago, and the first local appearance of *Pulleniatina obliquiloculata* near the extinction horizon of *Globorotalia miocenica*, near the upper Olduvai event at about 2.0 m.y. ago. Results are in good agreement with deep-sea core data and demonstrate the feasibility of supplementing and amplifying such data from land-based stations. — DBV

04246 **Rogers, C. L.; Kleinhampl, F. J.; Ziony, J. I.; Danilchik, Walter.** Phosphate occurrences in Nye County and adjacent areas, Nevada, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C49-C60, illus., tables, 1970.

Recent geologic studies in Nye County and adjacent areas, Nevada, have resulted in the recognition of phosphatic rocks which range in age from Cambrian to Permian(?) and which extend over an area of about 10,000 square miles. The phosphatic rocks are as much as 1.4 feet thick and contain as much as 19.4 percent P_2O_5. — Authors' abstract

04316 **Roland, G. W.** Phase relations below 575°C in the system Ag-As-S: Econ. Geology, v. 65, no. 3, p. 241-252, illus., tables, 1970.

Five ternary solid phases were encountered in quenching experiments. proustite and xanthoconite (both Ag_3AsS_3), smithite and trechmannite (both $AgAsS_2$), and Ag_7AsS_6. Maximum temperatures at which proustite can coexist with Ag_7AsS_6, Ag_2S, As, or smithite are about 480°, 469°, 452°, and 409° C, respectivcly. The xanthoconite-proustite transition occurs between 180° C and 202° C, and proustite + silver is unstable relative to Ag_2S + As above about 190° C. Phase relations show that the $AgAsS_2$ modification associated with either realgar or orpiment would be trechmannite if equilibrium were maintained during low-pressure deposition and subsequent cooling. — *from* Author's abstract

03952 **Ronov, A. B.; Migdisov, A. A.** Zvolyutsiya khimicheskogo sostava porod shchitov i osadochnogo pokrova Russkoy i Severoamerikanskoy platform [Evolution of the chemical composition of the rocks of the shields and sedimentary cover of the Russian and North American platforms (with English summ.)]: Geokhimiya 1970, no. 4, p. 403-438, illus., tables, 1970.

The average compositions and history of geochemical development of the rocks constituting the shields and sedimentary cover of the Russian and North American platforms are compared for the first time, on the basis of a generalization of representative analytical data (more than 8,000 analyses). It is confirmed that the average composition of the "granitic" layer is almost identical on both continents, and the sedimentary covers strikingly similar. The main stages in the chemical evolution of the sedimentary strata on both continents from Archean times are traced for the first time. It is established that the evolution proceeded according to general laws, in close connection with the changes in composition of the outer layers of the Earth and the development of life. — DBV

03787 **Rooney, Lawrence F.; Ault, Curtis H.** Patterns of Devonian sand on the North American craton and their interpretation — Discussion [of paper by C. H. Summerson, and D. H. Swann, 1970]: Geol. Soc. America Bull., v. 81, no. 8, p. 2519-2520, 1970.

For the original reference see ibid., v. 81, no. 2, p. 469-490, 1969; Abs. North American Geology for July 1970. — VSN

04310 **Rose, Arthur W.; Dahlberg, Eric C.; Keith, M. L.** A multiple regression technique for adjusting background values in stream sediment geochemistry: Econ. Geology, v. 65, no. 2, p. 156-165, illus., tables, 1970.

A multiple regression method for quantifying effects of differing lithologies in the drainage basin of a stream sediment is described and applied to a survey of 7,500 sq mi in Pennsylvania. Effects of lithology are defined as the percentage of area in the drainage basin occupied by each rock type. Total Fe and Mn content is used to estimate Fe and Mn oxide content. Regression equations expressing Zn, Cu, Ni, Co, Cr, and V as a function of these factors account for 20 to 70 percent of total variance of each element. Iron content is responsible for a large proportion of the variation and appears to be a very important parameter in stream sediments. Comparison of observed with predicted values from the regression equation results in a group of anomalous values that appears to be more useful in mineral exploration than a similar group defined simply as values above some arbitrary or averaged background level. — *from* Authors' abstract

Rosenberg, Arthur S. *See* McKinney, Charles N. 04048

04236 **Rosenfeld, John L.** Rotated garnets in metamorphic rocks: Geol. Soc. America Spec. Paper 129, 105 p., illus., 1970.

Maximum rotation of schistosity and compositional banding in garnet results from a sequence of velocity gradients that have affected surrounding rock. Circumstances under which rotation is cumulative are described, assuming the garnet to be a rigid sphere. The geometric arrangement of a fiducial surface in a rotated garnet is described, using nested rings with a common axis. The unique twofold axis of symmetry is the rotational axis and the only straight line within the included surfaces.

Growth and rotation about a second axis not parallel to the first is recognized. Methods of determination of axial orientations and amounts of rotation for both stages of doubly rotated garnets are applied to samples from Vermont. Shear planes which are not slip surfaces of superposed deformation commonly parallel stratification planes. Other uses for rotated garnets in geologic structure interpretation are suggested. — *from* Author's abstract

Rosenman, Martin. *See* Ben-Menahem, Ari. 04339

04205 **Ross, Charles A.** Concepts in late Paleozoic correlations, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 7-36, illus., table, 1970.

Comparison of fossil zonation and radiometric ages shows only a dozen dates from upper Paleozoic rocks that are reliable in delimiting systems, series, or stage boundaries; most have some uncertain stratigraphic relations to fossil zones. Reasonable ages, in m.y., are: 345 for Devonian-Mississippian, 320 for Mississippian-Pennsylvanian, 280 for Pennsylvanian-Permian, and 224 for Permian-Triassic boundaries. To more precisely relate fossil zones to radiometric ages in upper Paleozoic strata, we must know much more about phylogeny and changes in paleogeography, their effect on faunal dispersal, their structural causes, and changes in other environmental factors. Compared lithologic correlation and fossil zonation show fusulinacean species commonly range through several cyclothems, suggesting rapid transgression and regression of biofacies. World-wide zonations based on ammonoids, corals, and foraminiferids indicate tectonically isolated and semi-isolated faunal provinces. — GDC

Ross, Donald S. *See* Helgeson, Gaylord A. 04366

Rosso, Samuel W. *See* Phillips, Tom L. 04195

04170 **Rothwell, G. W.; Taylor, T. N.** Structurally preserved calamite fructifications [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 756, 1970.

Rouse, Glenn E. *See* Srivastava, Satish K. 04328

03834 **Roy, D. M.; Faile, S. P.** Experimental introduction of excess Ar^{40} into a granitic melt [discussion of paper by W. S. Fyfe, M. A. Lanphere, and G. B. Dalrymple, 1969]: Contr. Mineralogy and Petrology, v. 27, no. 3, p. 258, 1970.

For the paper under discussion, *see* ibid., v. 23, no. 3, p. 189-193, 1969; Abs. North American Geology, April 1970. — HRC

Rucklidge, J. C. *See* Naldrett, A. J. 04413

Rupert, G. B. *See* Clark, George B. 04010

03881 **Rupke, N. A.** Sedimentary evidence for the allochthonous origin of *Stigmaria*, Carboniferous, Nova Scotia — Reply [to discussion of 1969 paper by L. Ferguson, 1970]: Geol. Soc. America Bull., v. 81, no. 8, p. 2535-2537, 1970.

For original reference see ibid., v. 80, no. 10, p. 2109-2114, 1969; Abs. North American Geology, March 1970.

Rye, Robert O. *See* Ohmoto, Hiroshi. 04416

Rynn, John M. W. *See* Sbar, Marc L. 04431

03955 **Sachdev, Sham L.; West, Philip W.** Concentration of trace metals by solvent extraction and their determination by atomic absorption spectrophotometry: Environmental Sci. and Technology, v. 4, no. 9, p. 749-751, tables, 1970.

A simple solvent extraction procedure for concentrating trace metals for subsequent determination by atomic absorption spectrophotometry is described for aluminum, beryllium, cadmium, cobalt, copper, iron, lead, nickel, silver, and zinc. Different kinds of organic solvents were examined. A solution of diphenylthiocarbazone, 8-quinolinol, and acetyl acetone in ethyl propionate has been found to be useful. Interference effects of 34 diverse ions and compounds were studied and the procedure developed is highly selective. With the exception of aluminum, all of the metals can be determined when present at the low parts per billion level in an aqueous solution. Sensitivity for aluminum is 0.1 μg per ml. The procedure is well suited for environmental studies and is significant because it includes the majority of the inorganic carcinogens. — Authors' abstract

Sackett, John. *See* McClure, Duane. 04437

04088 **Sahores, J. J.; Witherspoon, P. A.** Diffusion of light paraffin hydrocarbons in water from 2° C to 80° C, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 219-230, illus., tables, 1970.

[Movement of hydrocarbons through water is a basic consideration in the origin and migration of petroleum.] Diffusion coefficients have been measured for methane, ethane, propane, n-butane, n-pentane, and neopentane in pure water at temperatures ranging from 2° to 80° C. A previously reported linear relationship between log D and carbon number for paraffin hydrocarbons has been found to hold over this range in temperature. Diffusion coefficients were found to be approximately doubled for every 15° increase in temperature. A number of theoretical and empirical methods of predicting diffusion coefficients were examined in the light of these results, but none was found to be entirely satisfactory. — Authors' summary

Saint-Amant, Marcel. *See* Gaucher, Edwin. 04297

04109 **Salas, Guillermo A.** Areal geology and petrology of the igneous rocks of the Santa Ana region, northwest Sonora [with Spanish abs.]: Soc. Geol. Mexicana Bol. 1968, v. 31, no. 1, p. 11-63, illus., tables, geol. map, 1970.

In the Santa Ana area of northwestern Sonora, Precambrian metamorphic rocks predominate, forming N-S-trending sierras bounded by early Tertiary fault blocks. After Early Cretaceous deposition of carbonates, graywackes and extrusive rocks, which may have erupted under water in shallow eugeosynclinal basins, folding and faulting took place from Late Cretaceous to early Tertiary time. Three episodes of magmatic activity, interspersed with periods of weathering and erosion, occurred during Tertiary. Block faulting was concurrent with late stages of magmatic activity. A fissure eruption in late Pliocene or Pleistocene time produced a cover of basalts over extensive Tertiary clastic conglomerates. Petrology and petrogenesis of the igneous rocks are discussed. — EH

04331 **Saleem, Z. A.** A computer method for pumping-test analysis: Ground Water, v. 8, no. 5, p. 21-24, illus., table, 1970.

Knowledge of aquifer parameters is invaluable for quantitative description of geohydrologic systems and for optimal utilization of ground-water resources. Classical methods of pumping-test analysis are mostly graphical. The computer method for aquifer evaluation is an inverse analysis technique and is based on the principle of least squares. The sum of weighted squares of differences between observed drawdowns and calculated drawdowns is minimized, treating the aquifer parameters as decision variables. The method was successfully applied to four pumping tests, two in nonleaky confined flow systems, one in a leaky confined flow system and one in an anisotropic nonleaky confined flow system. Percentage differences between values of storativity and transmissivity obtained by the two methods are 24 and 16 percent respectively. — *from* Author's abstract

Salvas, R. J. *See* DeLory, F. A. 04009

Sammis, Charles. *See* Archambeau, Charles. 03977

Sanders, John E. *See* Friedman, Gerald M. 03780

04079 **Sanders, John E.** Stratigraphy and structure of the Triassic strata of the Gaillard graben, south-central Connecticut: Connecticut Geol. and Nat. History Survey Guidebook 3, 15 p., illus., 1970.

The Gaillard graben includes a stratigraphic succession, about 6,000 feet thick, ranging from upper New Haven Arkose into basal Portland Formation. The Talcott Formation, 1,000 feet thick and especially well displayed, consists of four volcanic units and three sedimentary units. Strata have been deformed into two major synclines (Saltonstall and Totoket) separated by a faulted anticline (North Branford); numerous faults cut the folded strata. Purpose of the trip is to demonstrate the stratigraphic succession, particularly of the Talcott, and to study lateral changes in sedimentary units parallel and perpendicular to the Triassic Border faults. Special emphasis is placed on the spectacular pillows and volcanic breccias of the upper Talcott units and on relations between the folds and faults. — *from* Author's abstract

Sato, Y. *See* Landisman, M. 03980

03816 **Satterly, J.** (compiler). Aeromagnetic maps of carbonatite-alkalic complexes in Ontario: Ontario Dept. Mines and Northern Affairs Prelim. Map P. 452 (revised), scales about 1 in. to 67 mi. and 1 in. to 4 mi., text, 1970; originally published 1968.

For original citation, *see* Abs. North American Geology, July 1968.

04387 **Savage, Donald E.; Curtis, Garniss H.** The Villafranchian Stage-age and its radiometric dating, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 207-231, illus., tables, 1970.

The Italian nonmarine Villafranchian, a most precisely typified European stage of Cenozoic age, has been applied throughout Eurasia and Africa on the basis of land-mammal species array, although some assemblages are younger than the type, or its lower boundary may not coincide with that currently accepted for Pleistocene. Large stratotype mammals, together with smaller mammals, mollusks and plants recently collected, provide a safer basis for correlation and better knowledge of Villafranchian ecology. Mammalian comparison, and potassium-argon dates in associated volcanic ash, lavas and basalts of France, California, and Idaho, support its correlation with the Blancan land-mammal age of North America. From evidence for start of glacial climate and widespread glaciation, and oldest glacial-deposit dates, the refined Pliocene-Pleistocene boundary is placed at about 2.6 to 3 m.y. B.P. — GDC

Savage, J. C. *See* Hastie, L. M. 04338

Sayles, F. L. *See* Manheim, F. T. 04375

04431 **Sbar, Marc L.; Rynn, John M. W.; Gumper, Frank J.; Lahr, John C.** An earthquake sequence and focal mechanism solution, Lake Hopatcong, northern New Jersey: Seismol. Soc. America Bull., v. 60, no. 4, p. 1231-1243, illus., 1970.

A sequence of 42 earthquakes was recorded at Ogdensburg, New Jersey, and 5 events of magnitudes of 1 to 1.5 were felt in the epicentral area, over a 4-month period in 1969. Short aftershock sequences were observed for three of the felt events. One earthquake, felt over an area of about 30 sq km, had a magnitude of 1.25 and an intensity of 4 near the epicenter, an unusually high intensity for such a small shock. Twenty-six earthquakes were recorded on high-frequency microearthquake equipment from October 16 to November 9; the 13 epicenters which could be located fall in an area of 1.5 × 3.0 km, at depths of 0.5-3.3 km. A composite focal mechanism solution indicates normal faulting with a slip plane dipping steeply SE and striking parallel to the structural trend. — DBV

04169 **Schabilion, J. T.** *Sphenophyllum lescurianum*, morphology, development, and taxonomic implications [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 756, 1970.

04165 **Scheckler, S. E.; Banks, H. P.** Evolutionary trends in primitive progymnosperms [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 755-756, 1970.

Scheiner, Bernard J. *See* Radtke, Arthur S. 04308

04226 **Schiffman, Robert L.; Chen, Albert T-F.; Jordan, Jane C.** An analysis of consolidation theories — Closure [to discussion of paper 6370, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1793-1795, 1970.

Paper 6370 (ibid., v. 95, no. SM1, p. 285-312, 1969) was cited in Abs. North American Geology, June 1969, and discussion by C. Viggiani, E. H. Davis, and H. G. Poulos (ibid., v. 96, no. SM1, p. 331-336, 1970) in June 1970.

04321 **Schiller, W.-R.; Gehlen, K. v.; Nielsen, H.** Hydrothermal exchange and fractionation of sulfur isotopes in synthesized *Zn*S and *Pb*S: Econ. Geology, v. 65, no. 3, p. 350-352, illus., tables, 1970.

First results are reported on experiments with sulfur exchange and fractionation under 'hydrothermal' conditions. Dilute NaHS solutions were used in all experiments. In exchange experiments NaHS was added to synthesized ZnS or PbS to obtain a 10-fold excess of S, and in fractionation experiments, S-isotope fractionation was studied during precipitation of ZnS or PbS from dilute $MeCl_2$ solutions after adding NaHS in the same concentration range as above. Results are given in tables. In exchange experiments, within 24 hours ZnS approaches complete exchange more nearly than PbS. In fractionation experiments, ZnS and PbS follow different courses when precipitated from aqueous solutions; PbS shows almost constant depletion in S-34 relative to NaHS solutions, but ZnS shows enrichment in S-34 at low temperatures and slight depletion above 217°C. — VSN

04030 **Schlee, John; Pratt, Richard M.** Atlantic continental shelf and slope of the United States — Gravels of the northeastern part: U.S. Geol. Survey Prof. Paper 529-H, p. H1-H30, illus., 1970.

Gravel is concentrated mainly on the glaciated part of the Atlantic continental margin — Gulf of Maine, Scotian Shelf, and northern part of Georges Bank. In the Gulf of Maine, gravel is subangular and is associated with sand, silt, and clay, in till-like deposits. On Georges Bank and the rest of the shelf, gravel is better sorted, better rounded, and associated with sand; it probably originated as outwash. Much coarse detritus has been rafted to the continental slope and rise. — JS

03960 **Schmidt, Birger.** Gravitational stress field around a tunnel in soft ground — Discussion [of paper by B. Hoyaux and B. Ladanyi, 1970]: Canadian Geotech. Jour., v. 7, no. 3, p. 346-348, 1970.

The original paper was published, ibid., v. 7, no. 1, p. 54-61, 1970; *see* Abs. North American Geology, February 1971. — GDC

04386 **Schmidt, Birger.** State of predictive art in subsidence engineering — Discussion [of paper 7187 by B. Voigt and W. Pariseau, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1841-1843, 1970.

Paper 7187 (ibid., no. SM2, p. 721-750, 1970) was cited in Abs. North American Geology, January 1971.

Schmitt, R. A. *See* Rey, P. 04232

Schmitt, Roman A. *See* Wakita, Hiroshi. 04071

Schmitter-Villada, Eduardo. *See* Cserna, Zoltan de. 04180

Schock, R. N. *See* Stephens, D. R. 04127

Scholz, C. H. *See* Sylvester, Arthur G. 04332

03908 **Schopf, J. M.; Schwietering, J. F.** The *Foerstia* zone of the Ohio and Chattanooga Shales: U.S. Geol. Survey Bull. 1294-H, p. H1-H15, illus., 1970.

Foerstia, an inconspicuous problematic fossil, is allied with pelagic algae. It is known only in a zone within the Huron Member of the Ohio Shale (Upper Devonian) or its apparent time equivalents, principally in the Appalachian interior basin. *Foerstia* was restricted stratigraphically and geographically by its need for a suitable littoral environment for reproduction. Probably such an environment existed for a short interval during Late Devonian along the southeastern shore of the transgressive epicontinental sea. The period represented probably coincided with the time the reproductive habitat persisted. Only about 20 *Foerstia* localities are now known, but this genus probably marks a consistent time zone in Eastern United States. Its distribution may be related to tidal currents in the Late Devonian sea. — JMS

Schwarcz, Henry P. *See* Sheppard, Simon M. F. 03831

Schwietering, J. F. *See* Schopf, J. M. 03908

04241 **Scott, Glenn R.** Quaternary faulting and potential earthquakes in east-central Colorado, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C11-C18, illus., tables, 1970.

Eight faults in east-central Colorado shifted in Quaternary time. The offsets are only tens of feet, but prove that the rocks beneath some parts of this region were unstable in Quaternary time. Faults along the west flank of the Sangre de Cristo Mountains probably present the greatest likelihood of future earthquakes, owing to their thousands of feet of pre-Quaternary movement and the lateness of their last movement less than 10,000 years ago. — Author's abstract

04050 **Segmüller, Armin.** Automated lattice parameter determination on single crystals, *in* Advances in X-ray analysis, V. 13 — Applications of X-ray analysis, 18th Ann. Conf., 1969, Proc.: New York, Plenum Press, p. 455-467, illus., tables, 1970.

A powder diffractometer linked to an IBM 1800 time-sharing computer is used for precision determination of lattice parameters with Bond's method of measuring the angle between two diffracting positions of the crystal, symmetric to the incident X-ray beam. After scanning the two diffraction line profiles, peak positions and lattice parameter are determined on line by the computer. Using these techniques, the lattice parameter of silicon has been determined on two crystals; results are compared with others. Wave lengths of the CuKα radiation used were taken from Bearden's recent precision measurements based on the lattice parameter of silicon as determined from density measurements. — *from* Author's abstract

03871 **Selander, Robert K.; Yang, Suh Y.; Lewontin, Richard C.; Johnson, Walter E.** Genetic variation in the horseshoe crab (*Limulus polyphemus*), a phylogenetic "relic": Evolution, v. 24, no. 2, 402-414, illus., tables, 1970.

Protein polymorphism and genic heterozygosity were studied, using electrophoretic techniques, in *Limulus polyphemus* (Merostomata, Xiphosura), a living representative of an ancient bradytelic (slowly evolving) line. Analysis of 24 proteins controlled by 25 genetic loci in 64 individuals from four localities showed that *Limulus* is not less genetically variable than some other animals belonging to horotelic lines (evolving at average rates), thus refuting the hypothesis that members of bradytelic lines have unusually low mutability. Single populations of *Limulus* are, on the average, polymorphic at 25 percent of their loci, and individuals are heterozygous at 5.7 percent of their loci; populations on the Gulf coast are more polymorphic than those on the Atlantic coast. The overall pattern supports the hypothesis that genetic variation in *Limulus* is adaptive, the polymorphisms being maintained by some form of balancing selection. — VMJ

04214 **Sen Gupta, Joy G.** Determination of carbon by non-aqueous titration after combustion in a high-frequency induction furnace — Application to rocks, stony meteorites and metallurgical samples [with French and German abs.]: Anal. Chim. Acta, v. 51, no. 3, p. 437-447, illus., tables, 1970.

Suitable non-aqueous titration methods have been developed for the determination of total carbon in silicate and carbonate rocks, stony meteorites and metallurgical

samples by a high-frequency induction furnace. The method has been extended to the determination of carbon dioxide in rocks, clay and limestones by the acid evolution method. Acetone either alone (for 0-10 mg C) or in 1:1 mixture with methanol (for 10-30 mg C) containing 0.6 percent (v/v) monoethanolamine and an excess of standard sodium methylate was found to be a better absorbent for carbon dioxide than pyridine. After reaction, the excess sodium methylate was back-titrated by a standard methanolic solution of benzoic acid with phenolphthalein as indicator. The method gives reliable results up to 47 percent total carbon dioxide. — *from* Author's abstract

Sendlein, L. V. A. *See* Simon, D. E. 04451

Sharp, William N. *See* Parker, Raymond L. 04015

03888 **Shattles, D. E.; Callahan, J. A.** Water-level and water-quality trends in aquifers along the Mississippi gulf coast, 1970: Mississippi Board Water Commissioners Bull. 70-1, 25 p., illus., tables, 1970.

Artesian water levels along the coast are declining 0.5 to 1.0 ft per year on the average; however, water levels are still above or only slightly below the land surface in most places, and considerable additional drawdown is economically available. The ground water is of good quality except in a few localities where the concentration of chloride exceeds 250 mg/*l*. Of the 43 wells that were resampled during 1969, 18 showed a decrease in chloride, 18 showed an increase, and 7 indicated no change since previous sampling. — Authors' abstract

03831 **Sheppard, Simon M. F.; Schwarcz, Henry P.** Fractionation of carbon and oxygen isotopes and magnesium between coexisting metamorphic calcite and dolomite: Contr. Mineralogy and Petrology, v. 26, no. 3, p. 161-198, illus., tables, 1970.

Coexisting dolomite and calcite from marbles and calcareous schists from Vermont and the Grenville Province of Ontario were investigated. Concordant equilibrium fractionations are given by 83 percent of the samples. Isotopic fractionation expressions differ significantly from the experimentally derived relations. Temperature ranges for the metamorphic zones in Vermont are: chlorite zone 210° to 295°C; biotite zone, 225° to 400°C; staurolite-kyanite zone, 110° to 550°C. Quench or recrystallization temperatures may be as large as 400°C below the inferred metamorphic maximum. Oxygen isotope disequilibrium in high-grade rocks, especially from Vermont is characterized by large negative $\delta O^{18}_{D} - \delta O^{18}_{Cr}$ values. The size of the equilibrium exchange system for carbon and oxygen isotopes and magnesium are less than a few inches across the inferred relict bedding. — *from* Authors' abstract

Sherif, M. A. *See* Bostrom, R. C. 04114

03999 **Shows, Thad N.** Water resources of Mississippi: Mississippi Geol. Econ. and Topog. Survey Bull. 113, 161 p., illus., tables, 1970.

Only a small part of the large quantities of water available for all purposes in Mississippi is being used. All municipal water supplies (except Columbus, Jackson, and Meridian which are partly supplied by wells) and a large number of industrial and irrigational supplies are from ground-water sources. The fresh water section extends to a maximum thickness of about 3,500 feet in Smith County; most areas are underlain by at least one or more aquifers which vary with geographic location. Well yields (about 500 gpm) vary according to need, but yields of up to 5,000 gpm have been recorded. Water levels have declined one to two feet per year in heavily pumped areas. Quality of ground water is good for most general purposes, with minor local problems. Large industrial development will probably continue to depend on surface water supplies. — *from* Author's abstract

Shrader, Ross E. *See* Larach, Simon. 04148

Siddiqui, Shamsul H. *See* Parizek, Richard P. 04330

04012 **Signer, Peter; McDowell, Fred W.** On-line Ar extraction system for rapid high-precision routine analysis, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 311-321, illus., table, 1970.

A great increase in the efficiency of radiogenic argon determinations without reduction of the quality of the data has been obtained with a specially designed system. The extraction oven, purification line, Ar-38 reservoir, and calibration system are all interconnected with the mass spectrometer. Getters and adsorption traps are designed for fast operation. Provision is made for storage of up to 40 samples within the vacuum system so that they can be analyzed in any order. This system allows the analysis of samples at 50 minute intervals. A typical set of analyses includes ten samples, two spike calibrations and three mass discrimination measurements and requires non-stop operation of the instrument for about 12 hours. The accuracy of the radiogenic argon determination is about 1 percent (1 σ). — Authors' abstract

04322 **Silberman, M. L.; Ashley, R. P.** Age of ore deposition at Goldfield, Nevada, from potassium-argon dating of alunite: Econ. Geology, v. 65, no. 3, p. 352-354, table, 1970.

The suitability of alunite for direct dating of ore deposits has been tested at the Goldfield, Nev., ore deposits where K-Ar dating of hypogene alunite was compared with results on biotite and sanidine. The 20.7 $\pm$0.4 m.y. alunite age falls within the 20.6 to 21.1 m.y. range of the latter two minerals, and demonstrates the suitability of alunite for direct dating of mineralization. Other Goldfield alunite samples and alunite from other areas will be studied to fully evaluate this conclusion. — VSN

Silberman, Miles L. *See* McKee, Edwin H. 03832

03803 **Silverberg, Robert.** Mammoths, mastodons and man: New York and London, McGraw-Hill Book Co., 223 p., illus., 1970.

04442 **Silverman, Melvin P.; Munoz, Elaine F.** Fungal attack on rocks, solubilization and altered infrared spectra: Science, v. 169, no. 3949, p. 985-987, illus., table, 1970.

Penicillium simplicissimum, isolated from weathering basalt, produced citric acid when grown in a glucose-mineral salts medium with basalt, granite, granodiorite, rhyolite, andesite, peridotite, dunite, or quartzite. After 7 days' growth as much as 31 percent of the silicon, 11 percent of the aluminum, 64 percent of the iron, and 59 percent of the magnesium in some of the rocks were solubilized, and a number of rocks showed altered infrared absorption in the silicon-oxygen vibration region. — Authors' abstract

Simmons, Gene. *See* Chung, D. H. 03969

04451 **Simon, D. E.; Elwell, J. H.; Sendlein, L. V. A.; Lemish, J.** Measurement of physical and chemical changes induced during weathering of a carbonate rock unit: Iowa Acad. Sci. Proc. 1969, v. 76, p. 320-329, illus., tables, 1970.

Changes which occurred during weathering of the Iowa Falls Member of the Mississippian Hampton Formation at Iowa Falls, Iowa, were investigated quantitatively. The physical properties measured were: a) compressive strength, b) pore sized distribution, c) porosity and d) permeability. Chemically determined calcite and dolomite contents are related to the physical changes by utilization of an extensive sample sequence. The following changes are shown to be associated with the weathering process: 1) pore space and the degree of its interconnectedness increases with weathering, 2) calcite and dolomite are leached out during weathering, and 3) the rate of removal of calcite is twice that of dolomite. — Authors' abstract

04381 **Simpson, H. James.** Tritium in Crater Lake, Oregon: Jour. Geophys. Research, v. 75, no. 27, p. 5195-5207, illus., tables, 1970.

The transfer of tritium from the atmosphere to the ocean and to continental water bodies by vapor exchange as well as by precipitation is generally accepted. Vapor

exchange has been suggested as the dominant mechanism for transfer of tritium to small continental lakes. Evidence is presented here to suggest that input by precipitation can explain most of the tritium content of Crater Lake, Oregon. The hydrology of Crater Lake makes it ideal for this study because less than one-half of 1 percent of the lake volume is lost by seepage each year and because there is no surface outflow. Very little tritium can be lost from the lake by vapor exchange because the surface concentration is diluted by vertical mixing. If Crater Lake has retained nearly all its input tritium, and if less than half of this input was supplied by vapor exchange as derived from budget calculations, deep lakes with small drainage basins can provide good estimates of the total tritium rainout. — Author's abstract

03916 **Sisco, H. G.; Whitehead, R. L.** Ground-water levels in Idaho, 1970: Idaho Dept. Water Adm. Water Inf. Bull. 18, 73 p., illus., tables, 1970.

Ground-water levels in Idaho vary considerably depending on geographic location of well, the aquifer, quantity and rate of withdrawal from or in vicinity of well, and time of year when water-level measurements are made; long-term declines or rises may result from climatic changes or changes in quantities pumped per unit of time. Included in this report are maps showing location of all network wells, water levels measured in the spring of 1969 and spring of 1970, and hydrographs representative of water-level trends. — MCM

Skaggs, Samuel R. *See* Blander, Milton. 04119

Skinner, Brian J. *See* Graf, Joseph L., Jr. 04313

04139 **Skwarko, S. K.** An Upper Jurassic *Apiotrigonia* from Mexico [with Spanish abs.]: Soc. Geol. Mexicana Bol. 1968, v. 31, no. 2, p. 75-78, illus., 1970.

Goniomya calderoni Castillo and Aguilera, 1895, from the Alamitos sedimentary unit of the Sierra de Catorce, Mexico, is redescribed as *Apiotrigonia calderoni*. Its possible dating as Late Jurassic, makes it the oldest known representative of genus *Apiotrigonia*, which basically is a Late Cretaceous genus. — Author's abstract

04187 **Slaughter, Bob.** Were the first Americans caucasoid?: Texas Jour. Sci., 21, no.4, p. 483-486, illus., 1970.

Archeologists seem to be accepting the probability of man entering the New World via the Bering landbridge over 18,000 yr B.P. Slaughter suggests that the Ainu, essentially Cro-Magnon, were the first to occupy Asia, and may have given rise to early American cultures, Llano, etc. The Mongolians are the last of the basic races to appear. — ESL

04113 **Smith, Charles Isaac.** Lower Cretaceous stratigraphy, northern Coahuila, Mexico: Texas Univ. Austin Bur. Econ. Geology Rept. Inv. 65, 101 p., illus., tables, 1970.

Early Cretaceous seas transgressed the Tamaulipas and Coahuila Peninsulas and marine deposition persisted until Late Cretaceous time. In the lower part of the Cretaceous System in northern Coahuila, the Coahuila Series is subdivided into the basal La Mula Shale and overlying Cupido Limestone. Above it the Comanche Series is subdivided into the Trinity, Fredericksburg,and Washita Groups, and the informally named Aurora lime mudstone. The Aurora is equivalent in age to upper Trinity, Fredericksburg and lower Wichita but of different facies. These units are closely related parts of a continental shelf and oceanic basin sedimentary complex developed and terminated during Comanche time. — *from* Author's abstract

04404 **Smith, Donald E.; Murthy, M. K.** Silica-kaolin deposits of Algocen Mines Limited — Pt. 1, Exploration and geology: Canadian Mining and Metall. Bull., v. 63, no. 699, p. 799-809, illus., tables, 1970.

The deposit occurs on the banks of the Missinaibi River in the District of Cochrane, Ontario. Drilling information and an occasional outcrop indicate that much of the area is underlain by Devonian rocks, depressions in which are filled with Cretaceous

silica sand and clays. Cretaceous-Holocene material found in a drill hole is described, and suggestions as to the origin of the deposits are given. Reconnaissance mapping and auger testing and sampling suggested the presence of large deposits of silica-kaolin material, and a major drilling program was planned and airphotos taken. Quartz and kaolin clay are the principal minerals; impurity minerals are: an Fe-Ti oxide, goethite, muscovite, tourmaline, staurolite, anatase, and zircon. Studies are in progress to develop methods for separating silica sand from kaolin. The clay portion can also be beneficiated to meet commercial requirements. — ESL

03772 **Smith, Douglas.** Mineralogy and petrology of the diabase rocks in a differentiated olivine diabase sill complex, Sierra Ancha, Arizona: Contr. Mineralogy and Petrology, v. 27, no. 2, p. 95-113, illus., tables, 1970.

This Precambrian complex is more than 700 feet thick and is a multiple intrusion with a central feldspathic, olivine-rich diabase layer and upper and lower layers of olivine diabase derived from a high-alumina basalt magma. Principal primary minerals are plagioclase, augite, olivine, orthopyroxene, magnetite, and ilmenite. Ilmenite from reaction exsolution of magnetite is different in composition from primary ilmenite. A systematic Fe-Mg partition between contacting olivine and orthopyroxene suggests that equilibrium prevailed on an extremely local scale during crystallization. Albite-diabase pegmatite contains augite, ferrosalite, albite, and iron-rich chlorite. Altered diabase and albite diabase also have unusually calcium-rich pyroxenes which are richer in calcium and lower in aluminum and titanium than basaltic augite. — *from* Author's abstract

Smith, John Ward. *See* Thomas, Harold E. 04063

04151 **Smith, L. A.** Joides Leg X, Gulf of Mexico [abs.]: Houston Geol. Soc. Bull., v. 13, no. 1, p. 20, 1970.

Smith, M. D. *See* Hartronft, B. C. 04364

04005 **Smith, P. M.; Watson, R. A.** The development of the Cave Research Foundation: Studies Speleology 1969, v. 2, pt. 2, p. 81-92, illus., table, 1970.

The Cave Research Foundation was established in the U.S.A. in 1957 to support exploration and research in caves, to assist in the interpretation of cave and karst features to the public and to aid conservation in caves. Initially work was restricted to the Central Kentucky Karst. An outline of the history of the exploration of caves in the Mammoth Cave area of Kentucky from pre-Columbian times to the present day is followed by a description of the organization of the C.R.F. and of exploratory, cartographic and scientific work carried out by this body. — Authors' summary

04068 **Smith, Stewart W.; Jungels, Pierre.** Phase delay of the solid earth tide: Physics Earth and Planetary Interiors, v. 2, no. 4, p. 223-238, illus., tables, 1970.

Tidal strain data from Isabella, Calif., and Nana, Peru, have been analyzed to determine the phase shift of the M_2 solid tide and the Love number combination $(h\text{-}3l)$. The phase advance of the tidal bulge is $3.0 \pm 1°$, and $(h\text{-}3l) = 0.475$. Tidal strain meters appear to be more suitable for such measurements than do gravimeters. Indirect tidal effects due to ocean and atmosphere loading of the crust are minimized by performing the tidal analysis on the areal dilatation rather than on individual strain components. The lunar retarding torque calculated from this result is $(5.7 \pm 1.7) \times 10^{25}$ dyne cm which is in agreement with the value obtained from discrepancies in the lunar orbit. The tidal effective Q determined here is 10, which is entirely controlled by losses in the ocean and atmosphere and has no bearing on the anelasticity of the solid Earth. — Authors' abstract

Smith, Stewart W. *See* Sylvester, Arthur G. 04332

Solorio-Munguía, Jose. *See* Cserna, Zoltan de. 04180

04061 **Sommers, L. E.; Harris, R. F.; Williams, J. D. H.; Armstrong, D. E.; Syers, J. K.** Determination of total organic phosphorus in lake sediments: Limnology and Oceanography, v. 15, no. 2, p. 301-303, tables, 1970.

A comparison of five methods differing in principle and complexity showed that one involving sequential extraction with hot HCl and cold and hot NaOH [N. C. Mehta et al., 1954] was best for the routine determination of organic phosphorus in lake sediment. Total organic phosphorus ranged from 23 to 147 mg P per 100 g oven-dried sediments and from 8 to 63 percent of the total phosphorus. [Sediment samples from eight lakes in Wisconsin (three calcareous, five noncalcareous) were used.] — Authors' abstract

03804 **Sowers, George B.; Sowers, George F.** Introductory soil mechanics and foundations (3d edition): New York and London, Macmillan Co., 556 p., illus., tables, 1970; originally published 1951.

Sowers, George F. *See* Sowers, George B. 03804

Spackman, W. *See* Given, P. H. 04091

Speers, G. C. *See* Hobson, G. D. 04185

04046 **Spencer, Jean M.** Geological influence on regional health problems: Texas Jour. Sci., v. 21, no. 4, p. 459-469, illus., 1970.

Trace elements, derived from rocks of an area, enter soil and water to become available for plant and animal uptake. The geology of each area, therefore, controls areas of pathological conditions associated with excesses or deficiencies of these elements. Soft teeth in fluoride-deficient areas and goiters in iodine-deficient areas are well known. Not so well known are increased rates of osteoporosis and aortic calcification in low-fluoride areas and the suspicious relationship between iodine-deficient areas and breast cancer. Zinc-deficient bodies do not attain normal growth or physical maturity unless zinc treatment is begun. Kidney disease along two rivers in Yugoslavia has been attributed to environmental factors, but to date no cause has been discovered. Other areas of regional diseases are known, and more needs to be learned about the geochemistry of trace elements. — *from* Author's abstract

04328 **Srivastava, Satish K.; Rouse, Glenn E.** Systematic revision of *Aquilapollenites* Rouse 1957: Canadian Jour. Botany, v. 48, no. 9, p. 1591-1601, illus., table, 1970.

The original diagnosis of the genus *Aquilapollenites* is inadequate. It is suitably emended here and a revised generic diagnosis is given. The validity of the genera *Aquilapollenites* and *Pentapollenites* is examined. It is concluded that *Aquilapollenites* has seniority over *Pentapollenites*. The holotypes of the type species *Aquilapollenites quadrilobus* and *A. trialatus* have been lost. These two species are redescribed in detail and their neotypes selected. *A. formosus* is described as a new species from the Upper Cretaceous Oldman Formation of Alberta. — Authors' abstract

03989 **Stanley, Daniel J.** The ten-fathom terrace on Bermuda, its significance as a datum for measuring crustal mobility and eustatic sea-level changes in the Atlantic [with German and French abs.]: Zeitschr. Geomorphologie, v. 14, no. 2, p. 186-201, illus., 1970.

A prominent terrace on the upper Bermuda platform between 15-22 m and commonly at about 18 m (10 fms) is older than Wisconsin age and could be correlative with the 10-fathom terraces recognized in the Pacific area. The terrace extends from the outer platform margin to the lagoon, passing beneath reef complexes and some eolianite units. This feature and the deeper notch at 30-35 fms may reflect the repetitive Quaternary emergence and submergence of the area. Evidence that the upper terrace is relict includes the honeycombed and dissected topography of the surface, the drowned eolianite ridges, and other morphologic features. Lateral correlation with the Bahamas and Barbados failed to identify a repetition of the 10-30 fm terrace-pair. However, the different terrace levels in other areas may reflect the amount of crustal warping in a known mobile area. — VSN

Stanley, R. S. *See* Hatch, N. L., Jr. 04029

04312 **Stanton, R. L.; Willey, Helen Gorman.** Natural work-hardening in galena, and its experimental reduction: Econ. Geology, v. 65, no. 2, p. 182-194, illus., tables, 1970.

Specimens of naturally deformed galena were annealed at temperatures up to 500°C. Softening, measured by Vickers hardness, increases with temperature and time, as does narrowing of X-ray peaks. Below about 300°C, softening is a recovery process. Above this temperature, it is due primarily to recrystallization. Retention of work hardening can be a measure of the amount of exposure to elevated temperatures since deformation. The occurrence of an undeformed mineral, that may be annealed, with a deformed mineral that may anneal at higher temperature clearly does not establish the relative ages of formation of the two minerals. — WSW

03852 **Statton, C. Tom.** Faunal assemblage study of the Maryland Miocene [abs.]: Indiana Acad. Sci. Proc. 1969, v. 79, p. 253, 1970.

04127 **Stephens, D. R.; Heard, H. C.; Schock, R. N.** High-pressure mechanical properties of tuff from the Diamond Dust site — UCRL-50858: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., 15 p., illus., tables, 1970.

The strength, acoustic velocities and pressure-volume relationship were studied as a function of pressure for ten Area 16 tuffs near the Diamond Dust site [Nevada). Results are typical for weak, wet tuffs. Shear strengths are low, 100-400 bars, and show moderate variation with pressure. Acoustic velocities are low, and high-frequency waves are severely attenuated. The tuffs are very compressible and show collapse of gas-filled voids at 1 kb or less. Phase transformations due to water are apparent at 10-12 and 22-25 kb. Two units of tuff, 3 and 4a, are significant for the Diamond Dust Event. Within each unit the mechanical properties are reasonably uniform, but vary somewhat between units. Based on our measurements, stress-wave propagation should be different in the two formations. — *from* Authors' abstract

Steven, Thomas A. *See* Lipman, Peter W. 03777

Steven, Thomas A. *See* Lipman, Peter W. 04242

04125 **Stevens, Margaret Skeels.** *Merychyus verrucomalus*, a new species of oreodont (Mammalia, Artiodactyla) from the middle Miocene Runningwater Formation: Am. Mus. Novitates, no. 2425, 11 p., illus., table, 1970.

Seven skulls among the oreodonts in a collection at the Museum, had well-developed tuberosities on the anterior part of the zygomatic arch below the orbit. These specimens represent a distinct species, *Marychyus verrucomalus*, within the genus. Systematics are given, and it is described and illustrated. Nomenclature of rock-stratigraphic units and local fauna are shown in a chart. — ESL

Stevens, R. D. *See* Wanless, R. K. 04096

Stevens, Robert D. *See* Wanless, Robert K. 03926

04090 **Stevenson, F. J.; Tilo, S. N.** Nitrogenous constituents of deep-sea sediments, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 237-263, illus., tables, 1970.

The distribution of forms of nitrogen has been examined in sediments from the experimental Mohole off Guadalupe Island, Mexico. Microanalytical techniques are described for determination of fixed NH_4^+-N, amino acid-N, and amino sugar-N. One significant result is that a significant fraction of total nitrogen (10.0 to 21.5 percent) occurred as fixed NH_4^+; the variation of total amount of fixed NH_4^+-N is attributed, in part, to differences in carbonate levels, indicating that the clay-sized fraction of each sediment is somewhat similar in NH_4^+ fixing capacity. Organic nitrogen contents of sediments varied considerably with no apparent consistent change with depth. Data on the forms of nitrogen determined are summarized in a table. Only from about 1/4 to 1/2 of the nitrogen is accounted for in known compounds. — VSN

04299 **Stevenson, William G.** Role of the prospector in mineral exploration: Canadian Mining and Metall. Bull., v. 63, no. 698, p. 708-710, tables, 1970.

With the author's background of extensive experience, this paper delineates the role of the prospector in modern-day exploration programs. The stages in the development of a prospect to a producing mineral district are outlined and examples are given from the Ross River area of the Yukon Territory and the Peachland and Highland Valley areas of British Columbia. — Author's abstract

03862 **Stewart, John H.** Correlation of Lower Cambrian and some Precambrian strata in the southern Great Basin, California and Nevada, *in* Geologic guide to the Death Valley area, California — Geol. Soc. Sacramento, Ann. Field Trip Guidebook 1970: Sacramento, Calif., Geol. Soc. Sacramento, p. 1-7, illus., reprinted 1970; originally published 1966.

This paper was published originally in U.S. Geol. Survey Prof. Paper 550-C, 1966; *see* Abs. North American Geology, January 1967.

Stewart, Wendell J. *See* Kottlowski, Frank E. 04326

04327 **Stewart, Wendell J.** Fusulinids of the Joyita Hills, Socorro County, central New Mexico: New Mexico Bur. Mines and Mineral Resources Mem. 23, p. 34-82, illus., tables, 1970.

Fusulinids occur in great abundance throughout the interval of Pennsylvanian sediments in the Joyita Hills. A new genus *Parafusulinella* is described with two new species, *P. propria* from the Joyita Hills, and *P. mexicana* from the Boca Grande Mountains of northwestern Mexico. Other new species described from the Joyita Hills include *Plectofusulina rotunda*, *P. coelocamara*, *P. fusiformis*, *Beedeina joyiyaensis*, *Wedekindellina elongata*, *W. alveolata*, *Triticites riograndensis*, and *T. liosepta*. — Author's abstract

Stidd, B. M. *See* Hall, J. W. 04161

04175 **Stidd, B. M.; Hall, J. W.** The reproductive organs of *Callistophyton* [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 757-758, 1970.

04196 **Stidd, Benton M.; Hall, John W.** The natural affinity of the Carboniferous seed, *Callospermarion*: Am. Jour. Botany, v. 57, no. 7, p. 827-836, illus., table, 1970.

A seed of *Callospermarion pusillum* has been found attached to a long slender stalk. Significant features of the seed based upon additional specimens are described. Secretory cavities in the integument are similar to those in the stem of *Callistophyton poroxyloides* and the fertile foliage bearing the pollen organ *Callandrium callistophytoides*. *Vesicaspora* sp. pollen similar to that found in *Callandrium* occurs in the pollen chamber. *Callistophyton*, *Callandrium*, and *Callospermarion* are considered to represent the detached organs of a new seed fern family, Callistophytaceae. — Author's abstract

04137 **Stokes, William Lee.** Scanty fossil evidence emphasizes correlation problems in northeastern Utah and southcentral Idaho: Brigham Young Univ. Geology Studies, v. 17, pt. 1, p. 41-49, illus., 1970.

The following examples illustrate special difficulties of dating thick sedimentary sections in which fossils are rare or absent. The Uinta Mountain Group, dated by C. King (1878) as Carboniferous on the basis of one fossil from float, by discovery of obscure Cambrian fossils, was later confirmed as Precambrian. The Dove Creek Group, a thick, structurally complex section of metasediments underlying the Late Pennsylvanian Oquirrh Formation, contains only crinoid columnals. Various workers have placed the sequence in the Precambrian and in most or all pre-Pennsylvanian systems. Stokes here proposes that the entire sequence may be Carboniferous, probably Pennsylvanian, on the basis of faunal evidence, thickness, lithology, and structural relation to the Ouachita-Wichita orogenic belt. — VMJ

04179 **Stone, David B.; Cameron, Christopher P.** Paleomagnetic investigations in Alaska *in* Alaska Sci. Conf., 20th, College, 1969, Proc.: Sci. Alaska 1969, p. 311-318, 1970.

Paleomagnetism is currently being used as a tool to interpret large scale structures in Alaska, and to investigate relative movements of crustal blocks in the northern Pacific. Atlantic Ocean spreading implies relative movement in the Arctic, and some major tectonic activity in the Alaska-Siberia area. The source of Paleozoic sediments on the North Slope of Alaska lay to the north. It is suggested that the Aleutians formed first as a straight ridge and were bent later. Paleomagnetic studies on basalts and andesites from Shemya and Adak Islands show a paleopole position for the first, somewhat displaced from the Miocene position for North America, while that for Adak is more consistent. Paleolatitudes of both islands are north of present latitudes. Petrography and chemical analysis of the rocks studied are important, and results of a literature search are being run into a computer program. — *from* Authors' abstract

Stone, J. F. *See* Nichols, J. D. 03933

04035 **Stone, William J.; Erickson, J. Mark.** A FORTRAN program for Folk's sandstone classification: Compass, v. 47, no. 3, p. 163-168, illus., 1970.

The classification of sandstones by existing schemes, especially that of Folk (1965, p. 114), requires considerable reworking of raw petrographic modal analysis data. The number of such tedious calculations usually involved in petrographic research warrants the use of a computer. A program, therefore, has been developed which, utilizing a special modal analysis data sheet, groups related lithologic constituents into the three end members employed in Folk's classification, converts their combined raw frequencies into percentages, and writes out the appropriate mineralogic clan. — Authors' abstract

04372 **Straka, Joseph J., 2d; Lane, H. Richard.** Evolution of some Lower Pennsylvanian conodont species: Lethaia, v. 3, no. 1, p. 41-49, illus., 1970.

The closely related *Idiognathoides noduliferus* and *I. sulcatus* underwent rapid morphologic diversification in the lower Morrowan, as recorded from the Primrose Sandstone Member of the Golf Course Formation in Ardmore basin, southern Oklahoma, and the Prairie Grove Member of the Hale Formation, northwestern Arkansas. The expanding range of variation of the two species overlapped, producing a completely intergraded morphologic-continuum. Nonintergradation and taxonomic differentiation at stratigraphically higher levels in the Morrowan demonstrate that certain morphotypes in the continuum were potential chronospecies. The descendant species include *Idiognathoides sinuatus*, *I. macer*, *Gnathodus bassleri symmetricus*. Conventional systematic techniques are inadequate to depict the morphologic complexity and evolution shown by this example. — *from* Authors' abstract

03892 **Strangway, David W.** History of the Earth's magnetic field: New York and London, McGraw-Hill Book Co., 168 p., illus., 1970.

This text fills the gap of an introductory book in the fields of paleomagnetism and rock magnetism. — MCM

04238 **Stuiver, Minze.** Oxygen and carbon isotope ratios of fresh-water carbonates as climatic indicators: Jour. Geophys. Research, v. 75, no. 27, p. 5247-5257, illus., table, 1970.

Carbonates and molluscs from sediments of four lakes in Maine, New York, Indiana and South Dakota show increased O-18 content during the hypsithermal interval. This increase suggests higher mean annual temperatures for this interval than found at present. The changes in O-18 content not correlative with temperature changes are small, indicating stable atmospheric circulation patterns for the regions studied. The influence of seasonal variations in O-18 content of atmospheric precipitation on the O-18 content of carbonates is discussed for a small lake in Connecticut. The C-13 content of fresh-water carbonates appears a less useful climatic indicator than O-18 content. — Author's abstract

Sucharitakul, Mrs. N. *See* Buravas, S. 04368

Suhr, N. H. *See* Medlin, J. H. 04083

04301 **Sullivan, Charles John.** Relative discovery potential of the principal economic metals: Canadian Mining and Metall. Bull., v. 63, no. 699, p. 773-784, illus., table, 1970.

The ability to produce a metal depends on its primary abundance in the Earth's crust, the degree to which it has been concentrated by geologic processes, and the price. The relative concentratability of metals by natural thermal processes is shown on a graph. Statistics and geology and exploration history are given for each of nine metals: copper, lead, zinc, silver, tin, nickel, molybdenum, uranium, and gold. The author considers that any metal which may be concentrated by geologic processes into a vein or lode, may also occur in disseminated form and it is up to geologists to find them. – ESL

03884 **Summerson, Charles H.** Patterns of Devonian sand on the North American craton and their interpretation — Reply [to discussion of 1970 paper by L. F. Rooney and C. H. Ault, 1970]: Geol. Soc. America Bull., v. 81, no. 8, p. 2521-2522, 1970.

For the original reference, see ibid., v. 81, no. 2, p. 469-490, 1969; Abs. North American Geology, July 1970. — VSN

04095 **Swain, F. M.; Pakalns, G. V.; Bratt, J. G.** Possible taxonomic interpretation of some Palaeozoic and Precambrian carbohydrate residues, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 469-491, illus., tables, 1970.

The carbohydrate residues in various samples of Precambrian rocks and Paleozoic fossils and rocks from North America have been analyzed and compared with those obtained in Recent fresh-water and marine algae, aquatic higher plants, and marine invertebrate animals. The types of organisms that could have been responsible for the fossil carbohydrate residues are discussed; the source of Precambrian carbohydrate residues was most likely *Protista* or *Thallophyta*. Data are tabulated. — VSN

Swanson, Vernon E. *See* Ong, H. Ling. 04256

04106 **Sweet, John M.** Petroleum exploration in the north [abs.], *in* Alaska Sci. Conf., 20th, College, 1969, Proc.: Sci. Alaska 1969, p. 48, 1970.

Syers, J. K. *See* Sommers, L. E. 04061

Sykes, Lynn R. *See* Murphy, Andrew J. 03829

03992 **Sylvester, A. G.** Fluid pressure variations and prediction of shallow earthquakes: Science, v. 169, no. 3951, p. 1231-1232, 1970.

From recent evidence that shallow earthquakes can be triggered by increases in fluid pressure induced by man, it follows that tectonically induced increases in fluid pressure probably constitute an important mechanism for triggering shallow earthquakes. It may be possible to predict where some earthquakes are likely to occur in active areas by continuously monitoring fluid pressure variations in deep wells. This hypothesis can be tested in the Santa Barbara Channel where numerous wells and core holes penetrate nearly to the focal depths of some of the shallower local earthquakes. If confirmed, wells may be drilled along many of the major faults situated near densely populated areas, some to be used simply for prediction and others possibly to prevent destructive earthquakes by triggering a series of minor shocks by artificial injection of fluids. — DBV

04332 **Sylvester, Arthur G.; Smith, Stewart W.; Scholz, C. H.** Earthquake swarm in the Santa Barbara Channel, California, 1968: Seismol. Soc. America Bull., v. 60, no. 4, p. 1047-1060, illus., tables, 1970.

Sixty-three minor earthquakes (maximum magnitude = 5.2) occurred in the Santa Barbara Channel during the period June 26 to August 3, 1968. The epicenters form a shot-scatter pattern upon a broad, high-standing fault block in the channel midway between Santa Cruz Island and the City of Santa Barbara. Focal mechanism studies indicate that oblique-slip movement occurred along a northwest-striking fault even though the major folds and faults strike nearly east-west. Preliminary studies of the areal hydrocarbon production data show no compelling evidence for a causal relationship with the swarm. — Authors' abstract

03932 **Tabatabai, M. A.; Bremner, J. M.** Use of the Leco automatic 70-second carbon analyzer for total carbon analysis of soils: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 608-610, illus., tables, 1970.

Studies with soils containing 0.3-34 percent organic carbon showed that the Leco Automatic 70-Second Carbon Analyzer is satisfactory for determination of total carbon in soils. The results of total carbon analysis of soils by this analyzer agreed closely with, and were as precise as, those obtained by the wet combustion method of Allison. Total carbon analysis of soils with the Leco Analyzer is very simple and rapid, and a single operator can easily perform more than 150 analyses in a normal working day. — Soil brief

Taft, W. H. *See* Allen, R. J. 04421

04277 **Takahashi, Taro; Liu, Lin-gun.** Compression of ferromagnesian garnets and the effect of solid solutions on the bulk modulus: Jour. Geophys. Research, v. 75, no. 29, p. 5757-5766, illus., tables, 1970.

This paper reports compression data and bulk-modulus values for the end members of pyrope and almandite and for two natural ferromagnesian garnet specimens. In addition a genetic relationship between the chemical composition of binary solid solutions and the bulk modulus is derived, and a formula is presented which expresses this relationship. The seismic parameter for garnets may be expressed simply as a function of mean atomic weight, or can be related to the mole fraction of pyrope; the respective equations yield essentially the same relationship between the seismic parameter and chemical composition. The relationship between seismic parameter and mean atomic weight may be applicable to other ferromagnesian silicates and to the oxides. The bulk modulus data of Ryzhova and others (1966) for ferromagnesian natural garnets appear to be systematically too small by 10-15 percent. — DBV

03953 **Tan, K. H.; McCreery, R. A.** Possibility of the silylation technique in gas liquid chromatography of fulvic and humic acids: Geoderma, v. 4, no. 2, p. 119-126, illus., 1970.

Chromatograms of fulvic and humic acids extracted from a Greenville loan [Schley County, Ga.], had two distinct regions, based on retention time, one consisting of a group of peaks due to low molecular weight, and another of peaks due to higher molecular weight components. A hot-water extract was identified with infrared as a polysaccharide dominated by low molecular weight components; the HCl extract was similar but had more higher molecular weight components. Fulvic acid had both low and high components in the gas-chromatograms, but had a polysaccharide infrared spectrogram. Humic acid chromatograms were dominated by high molecular components. One HCl- and/or H_2O polysaccharide component seemed to prevail in both acids. There is some evidence that different pretreatments might cause a change in the nature and number of components extracted. — *from* Authors' abstract

Tarnocai, C. *See* Barakso, J. J. 04295

04359 **Taylor, Edward M.** The Three Sisters area [summ.]: Geol. Soc. Oregon Country News Letter, v. 36, no. 3, p. 16-17, 1970.

The Cascade Range consists of two parallel volcanic belts. The Western is older and peaks are remnants of resistant flows rather than sites of volcanoes. The High Cascades are younger and comprise large Cenozoic andesitic volcanoes upon a platform of coalescing basaltic shield volcanoes. A finer-grained, dense basalt overlies a

coarse-grained basalt unconformably to form the bulk of the platform. The boundary between belts is outlined by the western limit of the coarse-grained basalt, which inundated eastern foothills of the Western Cascades and followed major valleys westward. High Cascade rocks appear continuous with rocks of the lava plains. A variety of rocks erupted from Middle and South Sisters in the central High Cascades. North Sister is a glacially dissected remnant of a large cone on a broad shield volcano. In the central Cascades, three episodes of glaciation are recognized, most recent less than 2,000 years ago. — ESL

04303 **Taylor, O. James.** Optimization of conjunctive use of water in a stream-aquifer system, using linear programming, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C218-C221, illus., tables, 1970.

A linear program was used to show how conjunctive use of ground water and surface water in a stream-aquifer system can be manipulated to minimize depletion of the stream. The program was designed to achieve the objective by satisfying the demand for irrigation water, using ground water and surface water selectively during a 2-month period. — Author's abstract

Taylor, T. N. *See* Brack, S. D. 04167

Taylor, T. N. *See* Rothwell, G. W. 04170

04174 **Taylor, T. N.** Studies of pteridosperm fructifications [abs.]: Am. Jour. Botany, v. 57, no. 6, pt. 2, p. 757, 1970.

04217 **Taylor, Thomas N.** *Lasiostrobus* gen.n., a staminate strobilus of gymnospermous affinity from the Pennsylvanian of North America: Am. Jour. Botany, v. 57, no. 6, pt. 1, p. 670-690, illus., 1970.

Pollen cones are described from coal balls from the Mattoon Formation in southeastern Illinois. None of the cones is complete at the base. Six tangentially flattened endarch collateral primary vascular bundles parallel the cone axis and give rise to pairs of microsporophyll traces. Xylem elements have scalariform secondary wall thickenings. Microsporophylls are broadly attached to the cone axis and extend distally. The apical organization of one specimen is compared with vegetative and fertile apices of extant plants. Seven to ten pollen sacs are attached on the abaxial surface of each microsporophyll. Polysaccate pollen grains are small, spherical, and apparently inaperturate. The new cone is compared with staminate strobili of extant and fossil members of the cycadales and coniferales. — *from* Author's abstract

04307 **Teasdale, W. E.; Johnson, A. I.** Evaluation of installation methods for neutron-meter access tubes, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C237-C241, illus., 1970.

A detailed study was started in 1960 to evaluate methods for installing access tubes for a depth-type neutron-meter probe. At a small test site, soil-moisture content was determined by laboratory analysis of undisturbed volumetric samples and by a neutron-meter probe. Installation of thin-walled aluminum tubes of approximately the same diameter as that of the probe, in a hole small enough for tight contact between tube and soil, yielded most favorable results. Research also showed other less complicated, more economical methods of installing access tubes could be used with reasonable accuracy, if neutron-meter measurements made at the installation were calibrated against volumetric sampling at the site. Because of depths involved in ground-water studies one of the simpler, more economical installation methods is more practical than the skintight-fit method. — *from* Authors' abstract

04395 **Teeter, James W.** Paleoecology of a Pleistocene microfossil assemblage at the Fairlawn, Ohio, mastodon site: Am. Midland Naturalist, v. 83, no. 2, p. 583-594, illus., tables, 1970.

Thirteen species of ostracodes and selected plant matter collected in a vertical section exposed at Fairlawn, Ohio, reflect progressively shallowing conditions in Pleistocene lake sediments. — Author's abstract

Tettenhorst, R. *See* Lincoln, J. B. 04439

03810 **Texas Univ.AustinBur.Econ.Geology.** Geologic atlas of Texas, Waco sheet — Lloyd William Stephenson Memorial Edition: Austin, Tex., Univ. Texas Austin Bur. Econ. Geology, scale 1:250,000, separate text, 1970.

04063 **Thomas, Harold E.; Smith, John Ward.** Caliper location of leached zones in Colorado oil shale: Log Analyst, v. 11, no. 4, p. 12-16, illus., table, 1970.

Accurate estimation of oil yields in Green River Formation oil shale requires knowledge of the presence or absence of cavities (vugs) left after the natural removal of the mineral nahcolite ($NaHCO_3$). Conventional well logs have not provided a means for detecting the vugular porous zone. This paper describes a three-arm caliper logging system, logging technique, and mathematical correction method used by the U.S. Bureau of Mines to locate and compensate for the vugular porosity. The caliper defines the zone by sensing a high frequency of minor diameter variations as small as 1/10 inch. Estimations of oil yields and oil shale reserves from density logs can be significantly improved when the vugular zone's thickness is known. A porosity-density correction method is presented. — Authors' abstract

04084 **Thompson, Geoffrey; Bankston, Donald C.; Pasley, Susan M.** Trace element data for reference carbonate rocks: Chem. Geology, v. 6, no. 2, p. 165-170, table, 1970.

The reference carbonate rocks GFS 401, GFS 402, NBS 1a, NBS 1b, and NBS 1014 (all limestones), together with GFS 400, GFS 403, and NBS 88a (all dolostones), have been analyzed by emission spectrometric methods. Data for the trace elements Ag, Al, B, Ba, Bi, Cd, Co, Cr, Cu, Fe, Ga, Li, Mn, Mo, Ni, Pb, Rb, Si, Sn, Sr, Ti, V, Y, Zn, and Zr found by this technique have been tabulated, together with some previously reported results obtained by other workers. — Authors' abstract

04177 **Thorley, A.; Broise, Y.; Calhoon, M. L.; Zeman, Z. P.; Watt, W. G.** Borehole instruments for economical strength and deformation in-situ testing, Paper 13 *in* In situ investigations in soils and rocks — British Geotechnical Soc., Conf., London, 1969, Proc.: London, British Geotechnical Soc., p. 155-165, illus., tables; discussion, p. 189-220, illus., tables, 1970.

The instruments described are entirely of Canadian conception and the correlation results reported were acquired on the North American continent. All three instruments require a borehole, in the case of the probe and vane of normal rotary drill sizes, but of 61 cm in diameter for the pile device. Results obtained by these instruments are compared with those obtained by laboratory and field measurements by other, more conventional, equipment. Wherever possible, field performance by the structure involved has been reported. It would appear that these devices are useful and economical tools which can assist in the testing of soils and perhaps reduce the amount of laboratory testing, or at least aid in the control and the direction of a laboratory programme. — Authors' abstract

03778 **Thorman, Charles H.** Metamorphosed and nonmetamorphosed Paleozoic rocks in the Wood Hills and Pequop Mountains, northeast Nevada: Geol. Soc. America Bull., v. 81, no. 8, p. 2417-2447, illus., tables, geol. map, 1970.

Two structural units are juxtaposed along the Wood Hills thrust. Plate II overlies Plate I and contains nonmetamorphosed carbonates and clastics from Early Ordovician through Middle Permian in age. Within Plate II, two tectonic units have been juxtaposed along a transcurrent fault. Rocks typical of the western miogeosyncline occur north of the fault; rocks typical of the eastern portion occur south of the fault. Plate I consists of regionally metamorphosed Cambrian through Devonian miogeosynclinal strata. Metamorphism occurred in a synkinematic phase that attained the kyanite-staurolite zone, followed by a postkinematic phase. Following metamorphism the Paleozoic succession, both metamorphosed and nonmetamorphosed, was thrust northwestward over Precambrian rocks. Subsequently the nonmetamorphic rocks sheared off the metamorphic rocks along the Wood Hills thrust and moved east to southeast, truncating structures in the metamorphic rocks. — *from* Author's abstract

03791 **Thurston, P. C.; Carter, M. W.** Operation Fort Hope — Lansdowne House-Fort Hope sheet, District of Kenora (Patricia Portion): Ontario Dept. Mines Prelim. Geol. Map P. 562 (revised), scale 1 in. to 2 mi., 1970; originally published 1969.

Tilo, S. N. *See* Stevenson, F. J. 04090

Tipper, Howard W. *See* Campbell, Richard B. 04302

03904 **Todd, Ruth; Low, Doris.** Smaller Foraminifera from Midway drill holes: U.S. Geol. Survey Prof. Paper 680-E, p. E1-E49, illus., tables, 1970.

Over 400 samples from two cored drill holes yielded abundant free specimens of smaller Foraminifera. Both holes reached the basaltic foundation, one at 516 feet and the other at 1,261 feet. Miocene (Tertiary *g*) was reached at 445 feet in the Sand Island hole and at 500 feet in the Reef hole. Reef hole is Tertiary *e* (lower Miocene) below about 590 feet. *Austrotrillina striata*, a miliolid which became extinct in Tertiary *e* and has been known only in Europe, Asia, and the western Pacific, is abundantly present in the lower part of the Reef hole. All beds are interpreted as of shallow deposition, probably near or within a reef. — RT

Tournier, J. P. *See* Milovic, D. N. 04411

Tourtelot, Elizabeth B. *See* Vine, James D. 04317

Touzot, G. *See* Milovic, D. N. 04411

03886 **Traverse, A.; Ames, H. T.** (compilers). Catalog of fossil spores and pollen — Cumulative index, V. 21-30: University Park, Pa., Pennsylvania State Univ. Palynol. Labs., 166 p., 1970.

The third cumulative index of the Catalog differs from the preceding ones (Kremp, et al., ibid., V. 1-10, 1961, and ibid., V. 11-20, 1965) in combining the indexed taxonomic names in a single index with the formerly separate list of stratigraphic and geographic citations. Names of taxa treated in the Catalog by republication of descriptions are indexed under generic, specific, and infraspecific epithets; other references to the same taxa are indexed under generic citation only. In following sections are listed: names of all authors cited in V. 21-30, except authors of modern plant species or of nonpalynological taxa; bibliographic citations of publications covered in V. 21-30. — VMJ

04182 **Troncales, Alfred C.** Study of amplitude-period relation of volcanic tremors on basaltic volcanoes, *in* Individual studies by participants at the International Institute of Seismology and Earthquake Engineering, V. 5: Tokyo, Internat. Inst. Seismology and Earthquake Eng., p. 11-23, illus., tables, 1970.

Seismogram and oscillogram records of volcanic tremors at the basaltic volcanoes of Kilauea, Nyirangongo, Etna, and Mihara are examined, with emphasis on Kilauea Volcano as a typical example. It is shown that each volcano has a characteristic predominant vibration period regardless of time, the serious decay of higher frequency waves is strongly related to complexity of bedrock and looseness of superficial layers at each volcano, and the value of n , corresponding to amplification gradient of amplitudes initiated by the ground, varies at different localities. A comparative study of volcanic tremors and ordinary microseisms indicates ordinary microtremors have higher values of *n* than volcanic tremors, and the relation of amplitude to period may be a method for differentiating these two disturbances in volcanic areas. — VSN

03865 **Troxel, Bennie W.** Guide to selected features of Death Valley geology, *in* Geologic guide to the Death Valley area, California — Geol. Soc. Sacramento, Ann. Field Trip Guidebook 1970: Sacramento, Calif., Geol. Soc. Sacramento, p. 40-55, table, 1970.

Six mountain ranges bind Death Valley, and it contains the lowest point in the United States, -282 feet. The Precambrian rocks are divided into three groups; the oldest are igneous and metamorphic, the second and third each include three sedimentary formations. An alphabetical list of 59 principal pre-Tertiary sedimentary formations is included. — ESL

04276 **Tsai, Yi-Ben; Aki, Keiiti.** Precise focal depth determination from amplitude spectra of surface waves: Jour. Geophys. Research, v. 75, no. 29, p. 5729-5743, illus., table, 1970.

A method of using surface-wave amplitude spectra from shallow earthquakes for focal depth determination is proposed. The theoretical basis is established with the aid of the normal mode theory for surface-wave excitations caused by dislocations sources in a multilayered medium. Various practical aspects, such as crustal thickness, spatial and temporal behavior of source, and attenuation, are considered and shown to have relatively small effects on amplitude spectral shapes of surface waves as compared to focal depth. The method requires that fault-plane solution of an earthquake be known beforehand and that length of the fault be no longer than 10 km. An uncertainty of not more than 15° in the fault-plane solution will not seriously impair its applicability. Several earthquakes with known focal depths are used to test the proposed method, and show that focal depths from amplitude spectra of surface waves agree excellently with those from body-wave traveltimes. — *from* Authors' abstract

04333 **Tsai, Yi-Ben; Aki, Keiiti.** Source mechanism of the Truckee, California, earthquake of September 12, 1966: Seismol. Soc. America Bull., v. 60, no. 4, p. 1199-1208, illus., 1970.

With additional data on P wave polarities, the existing fault plane solution for the Truckee, Calif., earthquake of September 12, 1966 is revised to have nodal plane A strike N. 44° E. and dip 80° SE and plane B strike N. 134° and dip 90°. Nodal plane A agrees very well with the aftershock zone determined by Greensfelder (1968). The observed Rayleigh and Love wave amplitude spectrums from four WWSSN stations in the eastern United States are consistent with the revised solution, but not with the original one by Ryall and others (1968). The focal depth and seismic moment of the earthquake are determined as 10 km and 0.83×10^{25} dyne-cm, respectively. This focal depth is the same as that determined from the near station traveltime data by Ryall and others. The seismic moment is used to give a minimum estimate of about 30 cm for the average dislocation of the fault. — DBV

04390 **Turner, Donald L.** Potassium-argon dating of Pacific Coast Miocene foraminiferal stages, *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 91-129, illus., tables, 1970.

Forty-one K-Ar dates are reported from the Coast Ranges of California, Oregon, and Washington, and from Santa Cruz and San Clemente Islands, Calif. Radiometric ages for Pacific Coast Foraminiferal Stage boundaries are indicated in m.y. as follows: Zemorrian-Saucesian, 22.5; Saucesian-Relizian, 15.3; Relizian-Luisian, 14.5; Luisian-Mohnian, less than 13. One table indicates radiometric correlations between Pacific Coast Foraminiferal Stages and North American Land-Mammal Ages. Reported are 14 dates stratigraphically related to age-diagnostic marine megafossil assemblages. Radiometric correlation of Pacific Coast Megafossil "Stages" with other chronologies is not attempted because of doubt as to whether these "Stages" represent time-stratigraphic units. Problems associated with dating volcanic glass shards by the K-Ar method are discussed. — *from* Author's abstract

Turner, Francis J. *See* Verhoogen, John. 03811

Tyner, Edward H. *See* Cescas, Michel P. 03934

03806 **Upton, William Bayly, Jr.** Landforms and topographic maps, illustrating landforms of the continental United States: New York and London, John Wiley and Sons, 134 p., illus., 1970.

This book is an outgrowth of "Index to a set of one hundred topographic maps illustrating specified physiographic features" (Upton, 1955), but differs in that it is smaller, less expensive, and highly portable, containing only portions of the original quadrangles; it is intended for the beginning geology or physical geography student to illustrate vivid details of physiographic features of the surface geology of an area. The introduction contains explanations of topographic maps and landforms, instructions

on using the book, and a list of landforms keyed to the quadrangles on which the features are most clearly shown. The fifty topographic maps of continental United States encompass 34 states; each explanatory page contains location and physiographic features. A list of geologic maps covering the topographic quadrangles, a six-item bibliography, and a glossary of terms and definitions are appended. — MCM

04356 **Urban, J. B.; Padovani, E. Reeves.** A new scanning electron microscope specimen holder for palynology [with French abs.]: Pollen et Spores, v. 12, no. 1, p. 131-139, illus., 1970.

A new specimen holder and metal-coating technique facilitate examination of fossil palynomorphs by scanning electron microscope, as well as subsequent recovery and preservation of type specimens. The holder is a T-shaped brass plug, with upper diameter of 15 mm, designed to accept round glass coverslips in a shallow recessed area cut in the top, with a deeper slot for easy removal of the coverslips. Procedure is described for cleaning the holders, coverslips, and specimens, and coating specimens and coverslips with metal. A layer of 60 percent gold, 40 percent palladium alloy with maximum thickness of 500 A gives excellent contrast on the s.e.m., and still is thin enough to transmit light. After examination by s.e.m., the specimen is stuck to the coverslip with rapid-drying mounting medium, and then cemented onto a second coverslip for later examination by transmitted light microscopy. — VMJ

03794 **U.S. Geological Survey.** Bibliography of North American geology, 1966: U.S. Geol. Survey Bull. 1266, 1069 p., 1970.

03813 **U.S. Geological Survey.** Aeromagnetic map of part of western Minesota: U.S. Geol. Survey Geophys. Inv. Map GP-692, scale 1:250,000, 1970.

03814 **U.S. Geological Survey.** Aeromagnetic map of Antelope Valley and part of the Garlock fault zone, south-central California: U.S. Geol. Survey Geophys. Inv. Map GP-695, scale 1:250,000, 1970.

03875 **U.S. Geological Survey.** Aeromagnetic map of the Menominee-Northland area, Dickinson, Marquette, and Menominee Counties, Michigan, and Marinette County, Wisconsin: U.S. Geol. Survey Geophys. Inv. Map GP-711, 2 sheets, scale 1:62,500, 1970.

04239 **U.S. Geological Survey.** Geological Survey research 1970, Chap. C: U.S. Geol. Survey Prof. Paper 700-C, p. C1-C251, illus., tables, 1970.

The papers included in the second published chapter of "Geological Survey research 1970" report on scientific and economic results of current work by members of the Conservation, Geologic, and Water Resources Divisions of the U.S. Geological Survey. They are grouped under: (1) geologic studies — structural geology, economic geology, petrology and mineralogy, geophysics, geochemistry, geochronology, stratigraphy, analytical methods; (2) hydrologic studies — ground water, surface and ground water relationships, geochemistry of water, erosion and sedimentation, hydrologic techniques. Subject and author indexes are included. Most papers are cited individually. — BH

Usami, T. *See* Landisman, M. 03980

Uyeno, T. T. *See* Norford, B. S. 04100

Valentine, L. B. *See* Herz, Norman. 04245

vanBreemen, O. *See* Baadsgaard, H. 03893

04093 **Vastola, F. J.; Given, P. H.; Dutcher, R. R.; Pirone, A. J.** A laser-micropyrolysis system for the study of organic sediments and inclusions [abs.], *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 427, 1970.

04344 **Vedder, J. G.; Wallace, Robert E.** Map showing recently active breaks along the San Andreas and related faults between Cholame Valley and Tejon Pass, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-574, 2 sheets, scale 1:24,000, text, 1970.

The most conspicuous feature of the segment of the San Andreas fault is the large bend in the southern part between Santiago Creek and Tejon Pass; the fault trace deviates nearly 40° from its relatively consistent trend of N. 40° W. northward through the Carrizo Plain. Cause of this bend is highly conjectural. Observations suggest that the line of most recent ground breakage is likely to break again during future major earthquakes; however, surface fracturing may develop anywhere within the fault zone or on branching or otherwise related faults beyond the fault zone. Some traces of the fault have been modified and obscured by landslides. — MCM

03811 **Verhoogen, John; Turner, Francis J.; Weiss, Lionel E.; Wahrhaftig, Clyde; Fyfe, William S.** The earth, an introduction to physical geology: New York and London, Holt, Rinehart and Winston, 748 p., illus., tables, 1970.

Vey, Eben. *See* Wetzel, Richard A. 04223

04233 **Viebrock, J. M.** Determination of chromium, cobalt, iron, manganese, and nickel in silver by atomic absorption spectrophotometry: Anal. Letters, v. 3, no. 7, p. 373-383, tables, 1970.

The determination of chromium, cobalt, iron, manganese, and nickel by atomic absorption spectrophotometry in silver and silver alloys has been investigated. Samples containing from 2 μg to more than 500 μg in a two-gram sample of silver can be determined by using the same procedure. A series of twenty samples for each element at different concentrations gave an average standard deviation from linear regression analysis of 2.1 percent for iron, 1.9 for chromium, 2.9 for nickel, 1.6 for manganese and 2.8 for cobalt. The time required for analysis of these five elements in a two-gram sample, including sample dissolution and standard preparation, is approximately three and a half hours. — Author's abstract

Vigier, Gaston. *See* Londe, Pierre. 04392

04317 **Vine, James D.; Tourtelot, Elizabeth B.** Geochemistry of black shale deposits — A summary report: Econ. Geology, v. 65, no. 3, p. 253-272, illus., tables, 1970.

As interpreted from statistical analysis of chemical data, the detrital mineral fraction of most metal-rich black shale deposits is characterized by Al, Ti, Ga, Zr, Sc, and may include Be, B, Ba, Na, K, Mg, and Fe; the carbonate fraction includes Ca + Mg, Mn, or Sr. These elements are readily available from solution and are mobile. Organic fractions are locally enriched in mobile elements including Ag, Mo, Zn, Ni, Cu, Cr, V, and less commonly Co, Pb, La, Y, Se, U, Tl. Anomalously high syngenetic concentrations of these elements with organic matter are explained by higher than normal concentrations in sea water. Enrichment of minor elements with organic matter in black shales is an accumulative process throughout the history. Thin black shale beds may provide a local sink for minor elements after burial; thick units including much organic matter, exposed to hypersaline solutions, may be a source of mobile elements expelled and transported to more permeable rock bodies. — *from* Authors' abstract

Virgo, D. *See* Bush, W. R. 03905

Virgo, David. *See* Hafner, Stefan S. 04426

04073 **Vita-Finzi, C.** Alluvial history of central Mexico: Nature, v. 227, no. 5258, p. 596-597, illus., table, 1970.

Identifiable potsherds were found in the younger fill (Noche Buena) of 12 valleys in the central plateau of Mexico and datable charcoal in that of two. With the help of these two dates, a sequence of alluvial deposits is worked out. The Noche Buena fill dates from about A.D. 500-1700. From other evidence including radiocarbon dates, the older Becerra fill antedates 4,500-8,000 B.C. The local Pliocene-Pleistocene

boundary must provisionally be drawn at the base of the Becerra beds; this is difficult to reconcile with current views regarding the length of the Pleistocene and with interpretations of the corresponding oceanic record in terms of numerous major climatic oscillations. — DBV

03962 **Vogt, P. R.; Ostenso, N. A.** Magnetic and gravity profiles across the Alpha cordillera and their relation to Arctic sea-floor spreading: Jour. Geophys. Research, v. 75, no. 26, p. 4925-4937, illus., 1970.

Magnetic profiles over the Alpha cordillera have anomalies of wavelength 5 to 30 km and amplitudes frequently exceeding 1,000 gammas. Further, the profiles show a reasonable degree of mutual correlation and biaxial symmetry over the ridge crest. Finally, the profiles appear to correlate with those from the flanks of other well-documented ridges in the Greenland and Norwegian seas and can be matched with a sea-floor spreading model over the paleomagnetic time span of 40 to 60 m.y. B.P. From this evidence, as well as from newly presented gravity data and analysis of existing additional geophysical and geological information, it is concluded that the cordillera may have been a dormant mid-ocean ridge active at least between 40 and 60 m.y. B.P. If this hypothesis is correct, the spreading rate from the ridge axis was 1 cm per yr and ended abruptly 40 m.y. ago. — Authors' abstract

Volz, Gary. *See* Mooney, Harold M. 04007

vonHuene, Roland. *See* Reimnitz, Erk. 04244

04450 **vonSeggern, David.** The effects of radiation patterns on magnitude estimates: Seismol. Soc. America Bull., v. 60, no. 2, p. 503-516, illus., tables, 1970.

With a double-couple force system as a model of an earthquake source mechanism, the radiation pattern theory of Ben-Menahem is employed to show that far-field measurement of its strength can theoretically vary by more than a magnitude unit using either surface or body waves depending upon angles of slip motion and fault dip for a source at constant depth. Magnitude values determined by these waves do not change linearly in relation to slip and dip angles nor in relation to one another. Random selection of locations within the radiation pattern is used to determine extent of scatter in magnitude determinations which could be attributed to station distribution relative to source. The scatter in surface-wave versus body-wave magnitude plots for earthquakes could be severe if only a few stations are used to obtain average magnitude values. A method of obtaining consistent estimates of surface-wave magnitude is discussed. —*from* Author's abstract

Vormeringer, Raymond. *See* Londe, Pierre. 04392

Wahrhaftig, Clyde. *See* Verhoogen, John. 03811

04265 **Wait, Robert L.** Notes on the position of a phosphate zone and its relation to ground water in coastal Georgia, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C202-C205, illus., 1970.

Four inflection points occur on gamma-radiation logs from the coastal area of Georgia. Three of the inflection points are radiation peaks marking phosphate zones. Points A and B occur in the middle and lower Miocene, undifferentiated. Point A occurs in a sand at the base of the silty clay confining bed that lies above and protects the principal artesian aquifer from sea-water intrusion. Inflection point D occurs at the contact of the Oligocene and upper Eocene limestones. Mining of the phosphate zone marked by point A would breach the silty clay confining bed above the principal artesian aquifer and would allow intrusion of sea water into it. Such sea-water intrusion would destroy the ground water resources over a wide area of one of the Nation's largest artesian aquifers and would have dire economic consequences for this area. — Author's abstract

Wakita, H. *See* Rey, P. 04232

04071 **Wakita, Hiroshi; Schmitt, Roman A.** Rare earth and other elemental abundances in the Allende meteorite: Nature, v. 227, no. 5257, p. 478-479, table, 1970.

Abundances of 28 elements in the Allende meteorite, including 8 previously reported, are presented. All confirm the previous classification of Allende as a Type III carbonaceous chondrite. — DBV

03931 **Wall, Charles A.; Wall, Janet E.** "Where can I find. . ." — Resources and references in earth sciences: Jour. Geol. Education, v. 18, no. 4, p. 178-183, 1970.

This begins a new series of references in earth science for teachers. The purpose is to present a large number of sources of information for improving earth-science curricula, a listing of projects, and a list of journals and periodicals that most often carry earth-science information. The last is divided into categories. The list of Curricula in Earth Science features major projects devoted to development of earth-science curriculum materials. — ESL

Wall, Janet E. *See* Wall, Charles A. 03931

04130 **Wallace, D. E.; Cooper, L. R.** Dispersion of naturally occurring ions in groundwater from various rock types in a portion of the San Pedro River basin, Arizona: Jour. Hydrology, v. 10, no. 4, p. 391-405, illus., table, 1970.

Ground water in an alluvial basin in southern Arizona was analyzed for Ca^{++}, Mg^{++}, Na^{+}, and Cl^{-} concentrations. Ionic dispersion in ground water emanating from differing rock source areas is plotted as isogram maps. These isolated areas of differing mineral composition each exhibit a unique ionic contribution to ground water; ion concentrations were then used as naturally occurring tracers to determine source areas of recharge and to delineate subsurface barriers to the normal basin flow net. Ion dispersion plots reveal carbonates of the Dragoon Mts. to be a major contributor of Ca^{++} and Mg^{++} to the deep alluvial portion of the basin. Cl^{-} dispersion patterns show granitic intrusives of the Tombstone Hills produce a barrier effect in normal basin flow, as well as contribute Cl^{-} to ground water. — *from* Authors' abstract

Wallace, Robert E. *See* Vedder, J. G. 04344

04076 **Wang, Chi-Yuen.** Phase change in the upper mantle above 350 km: Nature, v. 227, no. 5261, p. 938-940, illus., 1970.

Evidence is presented to show that phase change may occur in the B region of the Earth's interior (upper 400 km) as well as in the C region. Calculations show that if the iron content of the upper mantle is uniform, the density increase between 150 and 350 km is somewhere between 8 and 12 percent. About one third to two thirds of the total density increase cannot be accounted for by self-gravitational compression and may be associated with phase transitions in mineral assemblages occurring in this depth range. — DBV

Wang, Herbert. *See* Chung, D. H. 03969

04096 **Wanless, R. K.; Stevens, R. D.; Lachance, G. R.; Delabio, R. N.** Age determinations and geological studies — K-Ar isotopic ages, Rept. 9: Canada Geol. Survey Paper 69-2A, 78 p., illus., 1970.

One hundred and forty-six new potassium-argon age determinations carried out on Canadian rocks and minerals are reported. In most instances the age determination is accompanied by a description of the rock and mineral concentrate used; brief interpretive comments regarding the geological significance of each age is also provided. The experimental procedures employed are described in brief outline and the constants used in the calculation of ages and isotopic abundances are listed. Two geological time scales are reproduced in tabular form for ready reference. — Authors' abstract

03926 **Wanless, Robert K.; Stevens, Robert D.; Loveridge, William D.** Anomalous parent-daughter isotopic relationships in rocks adjacent to the Grenville front near Chibougamau, Quebec, *in* Geochronology of Phanerozoic orogenic belts — Colloquium, Switzerland, 1969, Papers: Eclogae Geol. Helvetiae, v. 63, no. 1, p. 345-364, illus., tables, 1970.

The Rb-Sr whole-rock isochron technique has been applied to samples selected from the Dauversière Stock and from the Grenville Province immediately south of the front. Results appear to define a single isochron indicating an age of 2,610 ± 170 m.y. with an initial Sr-87/Sr-86 ratio of 0.7011 ± 0.0015. This evidence is believed to indicate that the rocks on either side of the boundary were formed during the same geologic period. Mineral isotopic evidence for those samples now located in the Grenville Province indicates that they were reconstituted during the Grenville orogeny. While the latter event was sufficiently intense to have modified both the K-40/Ar-40 and Rb-87/Sr-87 isotopic ratios of the constituent minerals, the whole-rock samples appear to have remained as closed systems for Rb and Sr. — *from* Authors' abstract

04444 **Warren, Nicholas W.; Latham, Gary V.** An experimental study of thermally induced microfracturing and its relation to volcanic seismicity: Jour. Geophys. Research, v. 75, no. 23, p. 4455-4464, illus., tables, 1970.

Unconfined samples of basalt, sintered and bonded perlite, insulating firebricks, and paraffin were subjected to thermal gradients of 15°-100°C per cm. Microshocks due to thermoelastic stress relief were detected by miniature accelerometers. Histograms of microshock occurrences all show that activity increases abruptly following onset of heating or cooling, reaches a maximum, and decays hyperbolically in approximate correlation with the time dependence of the thermal gradient. Later swarms of activity are initiated by small thermal fluctuations. Log-log plots of cumulative microshocks versus amplitude show kinks or knees. Values of the negative slope b for linear approximations to these plots are greater than for normal earthquake series and similar to those of volcanic B-type earthquakes. Possible explanations are offered. — DBV

Watson, R. A. *See* Smith, P. M. 04005

03796 **Watt, Arthur D.** Catalog of the illustrated Paleozoic plant specimens in the National Museum of Natural History: Smithsonian Contr. Paleobiology, no. 5, 53 p., 1970.

Watt, W. G. *See* Thorley, A. 04177

04224 **Weber, William G.** Performance of embankments constructed over peat — Closure [to discussion of paper 6333, 1969): Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1791, 1970.

Paper 6333 (ibid., v. 95, no. SM1, p. 53-76, 1969) was cited in Abs. North American Geology, June 1969, and discussions by R. E. Bigham and V. J. LoPinto (ibid., no. SM1, p. 309-310, 1969) in June 1970.

Webster, G. D. *See* Ovenshine, A. T. 04260

Wedow, Helmuth, Jr. *See* Ericksen, George E. 03818

Weeks, R. A. *See* Chaterlain, A. 04402

Weinke, H. H. *See* Kiesl, W. 04370

03858 **Weir, Gordon W.** Field trip No. 3, Borden Formation (Mississippian) in southeast-central Kentucky, *in* Guidebook for field trips — Geol. Soc. America, Southeastern Sec., 18th Ann. Mtg., Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, p. 29-48, illus., tables, 1970.

Some of the chief lithofacies of the Borden Formation, examined on this trip, are repeated in the section, and some intergrade. Their interrelations reflect complex patterns of deltaic environment, in part similar to that of the Borden Siltstone in Illinois. In southeast-central Kentucky several Borden units have initial dip to southwest or west; source of most clastics was to northeast or east. Visited type sections of the Halls Gap, Renfro, and Cowbell members, and an optional stop at the Broadhead section, are redescribed with modifications in four tables. Stratigraphic relations are shown in cross-section diagrams based, near Halls Gap, on detailed mapping and the rest on measured sections in the region. — GDC

03859 **Weir, Gordon W.** Field trip No. 4, Paleozoic section on east flank of Cincinnati Arch along Interstate 64, Lexington to Olive Hill, Kentucky — Pt. 1, Lexington eastward to valley of Licking River, *in* Guidebook for field trips — Geol. Soc. America, Southeastern Sec., 18th Ann. Mtg., Lexington, Ky., 1970: Lexington, Ky., Kentucky Geol. Survey, p. 49-56, illus., 1970.

For 20 miles along this east-west highway, scattered small outcrops are mostly rubbly-weathered, nodular-bedded limestone and shale of the Millersburg Member of the Lexington Limestone, intertongued with skeletal limestone of the Tanglewood Member. Best exposures of the Lexington are near Winchester, where some of the higher hilltops are capped by thin-bedded fine-grained limestone of the Clays Ferry Formation. A generalized stratigraphic section of the Ordovician, Silurian, and Devonian formations in the area between Mount Sterling and Owensville includes a comparison of present and previous nomenclatures. Their lithologies, contacts, and sedimentary structures are shown at five scheduled and two optional stops. — GDC

Weiss, Lionel E. *See* Verhoogen, John. 03811

03833 **Wenk, Hans-Rudolf.** Submicroscopical twinning in lunar and experimentally deformed pyroxenes: Contr. Mineralogy and Petrology, v. 26, no. 4, p. 315-323, illus., tables, 1970.

During deformation experiments at high pressures (10 kb) and medium temperatures (500-650°) diopside became twinned on {100} in small optically invisible domains. If host and twin occur with equal frequency, the X-ray single-crystal photograph would show orthorhombic symmetry due to the special geometry of the diopside lattice. A crystal of pyroxene from Mare Tranquilitatis has been found to give just such an X-ray photograph with orthorhombic symmetry; this is explained as a possible deformation product. — Author's abstract

04394 **Werner, Stuart D.; Adham, Samy A.** Seismic response of soil deposits — Discussion [of paper 7175 by I. M. Idriss and H. B. Seed, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1838-1841, illus., 1970.

Paper 7175 (ibid., no. SM2, p. 631-638, 1970) was cited in Abs. North American Geology, January 1971.

04086 **Wershaw, R. L.; Friedman, Irving; Heller, S. J.** Hydrogen isotopic fractionation of water passing through trees, *in* Advances in organic geochemistry — Internat. Cong., 3d, Proc. (G. D. Hobson and G. C. Speers, editors): London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 32), p. 55-67, illus., tables, 1970.

Results of a detailed study of hydrogen isotope fractionation in trees indicate that water in tree leaves is enriched in deuterium with respect to that in the phloem and xylem, which in turn is enriched in deuterium with respect to ground water. Enrichment in leaves is due to fractionation during transpiration, and amount of fractionation is apparently a function of rate of transpiration from the tree, in turn dependent on temperature, humidity, and solar radiation level. Enrichment of deuterium in phloem and xylem results from movement of water from leaves into trunk and from enrichment in soil water surrounding tree roots by evaporation. In soil samples from near Denver, Colo., water in the top 1 inch, where more evaporation occurs, has a δD value 2 percent higher than that of waters from lower zones. Data from all soil is generally lighter than residual water in leaves. — VSN

04311 **Wertz, Jacques B.** The Texas lineament and its economic significance in southeast Arizona: Econ. Geology, v. 65, no. 2, p. 166-181, illus., 1970.

Components or strands of the Texas lineament appear to have been broken and to follow slightly differing directions suggesting a mild, irregular bend within the whole belt. Places where successive changes in direction occur generally coincide with intersections of N-NW fractures. Recurring movements, remotely connected with the Murray transcurrent deep-seated fracture and San Andreas fault complex, causing increased torsional tangential effects, must have affected components of the Texas lineament as a whole, exerting a structural impact on all fracture centers within its confines in southeastern Texas. It is postulated that the lineament has increased potentialities for ore throughout the area by additional perturbance and fracturing, jarring loose some of the major fracture intersections and permitting better ground preparation as at Ajo, Tombstone, Bisbee, and other centers. — *from* Author's abstract

West, Philip W. *See* Sachdev, Sham L. 03955

04223 **Wetzel, Richard A.; Vey, Eben.** Axisymmetric stress wave propagation in sand: Am. Soc. Civil Engineers Proc., v. 96, paper 7539, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1763-1786, illus., tables, 1970.

Experiments were conducted in which a rigid cylindrical weight was dropped onto the surface of a bed of sand. Soil stress gages and soil strain gages embedded in the sand were employed to measure the soil response to the impacting weight. These measurements were analyzed to determine the effects of inertia on the soil behavior. Experimental results indicated, due to soil inertia during the initial phases of the impulse loading, the displacements were elastic with plastic behavior being evident in the stress measurements. Beyond the initial phase the inertia effects decreased and plastic behavior was noted in the strain and displacement measurements as well as the stresses. The results further indicated the response of a footing to an impulsive load may be divided into different inertial regimes depending on the rise time of the transient load. — ASCE abstract

04124 **White, John A.** Late Cenozoic porcupines (Mammalia, Erethizontidae) of North America: Am. Mus. Novitates, no. 2421, 15 p., illus., tables, 1970.

After publication of the paper describing *Coendou stirtoni* (White, 1968), some fossil porcupines from near El Casco, southern California, were lent to the author. After study of these and review of the earlier work, it appeared that a review was needed. The erethizontid porcupines are endemic to the Americas, and made their appearance in the late Pliocene or early Pleistocene. Systematics of *Coendou* are given and the new species, *C. cascoensis* and *C. cumberlandicus* described. White believes the genus *Echinoprocta* should stand until further study is made. *Coendou* evolved into *Erethizon* and *C. cumberlandicus* is intermediate. — ESL

04218 **White, John S., Jr.** New data for plattnerite: Mineralog. Rec., v. 1, no. 2, p. 75-80, illus., tables, 1970.

New X-ray, morphologic, chemical, and physical property data are reported here on plattnerite crystals from the Ojuela mine, Mapimi, Durango, Mexico. Also described is an unusual twin from White Pine County, Nevada. It typically occurs in oxidized lead ore deposits with good crystals limited to semi-arid areas. Ojuela mine plattnerite is developed on soft, porous limonite-goethite as druses and sprays of sharp crystals; hemimorphite and calcite are common among associated minerals. No significant refinement of data has appeared since Darbyshire (1932) and Davidson (1941). Jet-black and brittle, it is isostructural with rutile and similarly twinned, the symmetry ditetragonal dipyramidal. An angle table includes measurements on forms from Ojuela mine, You Like lode of Idaho (Yeats and Ayres, 1892), and Davidson's synthetic crystals. Tabulated X-ray powder data is from Ojuela mine and You Like lode. — GDC

White, William B. *See* Rauch, Henry W. 04064

Whitehead, J. A. *See* Howard, L. N. 04120

Whitehead, R. L. *See* Sisco, H. G. 03916

03986 **Wiebenga, William A.; Ellis, W. R.; Kevi, L.** Empirical relations in properties of unconsolidated quartz sands and silts pertaining to water flow: Water Resources Research, v. 6, no. 4, p. 1154-1161, illus., tables, 1970.

During a laboratory investigation using radiotracers, empirical formulas were developed to replace the ambiguous or incorrect Dupuit-Forchheimer assumption used in relationships governing the flow of water through porous, unconsolidated materials ranging from clay to coarse sands or fine gravel. The Dupuit-Forchheimer assumption states that the ratio of specific flow rate to average flow velocity is equal to porosity, but it is not specified whether true porosity or void ratio or specific yield, also called effective porosity, is meant. The hydraulic conductivity shows a good correlation with the maximum 10 percent grain size, and the ratio of specific flow rate to average flow velocity shows good correlation with functions of specific yield and percentile sorting coefficient. From field measurements of specific flow rate and average flow velocity the specific yield can be computed. — Authors' abstract

03853 **Wier, Charles E.** Factors affecting coal roof rock in Sullivan County, Indiana: Indiana Acad. Sci. Proc. 1969, v. 79, p. 263-269, illus., 1970.

Maintaining a safe and stable roof is both an economic and geologic aspect of an underground mine operation. Roof falls occur when the rock is too weak to support the overlying pressure across the open span where coal has been removed. Roof falls are related to characteristics of the rocks. They may be described as dust, lenticular, concretion, slate, clay squeeze and massive falls. Lithology and thickness of beds, jointing, strength of bedding plane bond, and the effect of moisture are important considerations. No single criterion seems to be adequate for practical roof evaluation. — Author's abstract

04186 **Wiethe, John D.** Textural parameters of a modern point bar: Compass, v. 47, no. 2, p. 110-118, illus., tables, 1970.

Statistical measures are applied in a study of sediments forming an active point bar. From the results a set of dominant characteristics useful in describing and distinguishing this type of sedimentary body is proposed. Causal factors and data from other studies are discussed. — Author's abstract

04315 **Wignall, T. K.** Generalized Bayesian classification functions, K classes — A reply [to 1970 discussion by E. C. Dahlberg of 1969 paper]: Econ. Geology, v. 65, no. 2, p. 221-222, 1970.

The paper discussed here (ibid., v. 64, p. 571-574) was cited in Abs. North American Geology, April 1970. — VSN

Willey, Helen Gorman. *See* Stanton, R. L. 04312

04427 **Williams, Dennis E.** Use of alluvial faults in the storage and retention of ground water: Ground Water, v. 8, no. 5, p. 25-29, illus., 1970.

Recent investigations of alluvial faults in California's Owens Valley reveal that they are semipervious in nature. The rate of ground-water movement through such a fault depends on the hydraulic conductivity of the fault gouge, its width, and the water-level differential across the fault. Optimization of ground-water resources in the valley is currently being practiced using these faults in a controlled Recharge-Extraction-Salvage System. Artificial recharge is induced into the aquifers upgradient from alluvial fault zones. Large-diameter supply wells near the faults on their upstream side extract ground water. The water is salvaged by lowering the water table near the faults. The induced water-level decline caused by backward leakage through the faults is calculated. — *from* Author's abstract

Williams, Ernest E. *See* Estes, Richard. 03915

Williams, J. D. H. *See* Sommers, L. E. 04061

04123 **Williams, John R.** A review of water resources of the Umiat area, northern Alaska: U.S. Geol. Survey Circ. 636, 8 p., illus., table, 1970.

Fresh ground water occurs in unfrozen zones in alluvium and in the upper part of bedrock beneath the Colville River and beneath lakes that do not freeze to the bottom in winter. Unfrozen zones, forming depressions in the upper surface of permafrost, are maintained by flow of heat from bodies of surface water into subjacent alluvium and bedrock. Brackish or saline ground water occurs in bedrock beneath as much as 1,055 feet of permafrost in the Arctic foothills and beneath 750-800 feet of permafrost beneath low terraces of the Colville River valley. The foothill area is unfavorable for developing supplies because of great depth to water, predominance of brackish or saline water, and low potential yield of bedrock. In the Colville River valley, shallow unfrozen alluvium beneath the river and deep lakes will yield abundant year-round supplies, but bedrock below permafrost yields less than 10 gpm of saline or brackish water. — *from* Author's abstract

04133 **Williams, Sidney A.** Bideauxite, a new Arizona mineral: Mineralog. Mag., v. 37, no. 290, p. 637-640, tables, 1970.

Bideauxite is a new mineral found in specimens from the Mammoth-St. Anthony mine, Tiger, Pinal County, Arizona. The composition is Pb_2AgCl_3 (F, $OH)_2$ with Pb, Ag, Cl, F by duplicate wet analyses, Z = 16, G. calc. 6.256, meas. 6.274 (at 24.2°C). Crystals are isometric hexoctahedral with a 14.132 A. Space group $Fd\bar{3}m$. Crystals show a, o, d, m {113}, μ {114}, n {112}, ϕ {116}, and {029} in decreasing order or importance. Colourless, transparent with white streak. Isotropic with n_D 2.192. Brittle, almost sectile, with conchoidal fracture. H = 3. Turns pale lavender in strong light. Low M.P. and B.P. Decomposes in acids and warm NH_4OH. Bideauxite is an oxide zone mineral found with boleite, leadhillite, matlockite, and anglesite. May alter to cerussite. — Author's abstract

04213 **Williams, Sidney A.** Tilasite from Bisbee, Arizona: Mineralog. Rec., v. 1, no. 2, p. 68-69, illus., tables, 1970.

Tilasite was first described from Långban, Sweden (Sjögren, 1895), and a second occurrence from India, by Smith and Prior (1911). At Bisbee it occurs in veinlets cutting clean crystalline limestone, in outcrop near the White Tail Deer mine. These veins have a gangue of calcite and braunite and carry both tilasite and conichalcite, well crystallized. Crystals of tilasite, easily found, range in size up to 6 mm, but the smaller ones are better suited for measurement; many show their monoclinic m symmetry and are quite complex. Among a number of forms, only {373} is certainly new. Morphologic and X-ray cell constants compared with results of previous workers are tabulated, also indexed powder pattern. — GDC

Williamson, Edward F. *See* Font, Robert G. 04383

04077 **Wilson, Charles W., Jr.; Barnes, Robert H.** Geologic map of the Bodenham quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 59-NW, scale 1:24,000, separate text, 1970.

Mined mineral resources in the Bodenham quadrangle are phosphate, chert, and gravel; a potential resource is limestone. — MCM

04103 **Wilson, G.** The square tube in subsurface exploration, Paper 11 *in* In situ investigations in soils and rocks — British Geotechnical Soc., Conf., London, 1969, Proc.: London, British Geotechnical Soc., p. 135-143, illus.; discussion, p. 189-220, illus., tables, 1970.

The paper discusses sample disturbance in relation to existing methods of subsurface exploration and points up the need for a critical review of soil sampling practices. A practising engineer questions the universal adoption of the cylindrical sample tube. A sampling tube of square section could provide not only an 'undisturbed' soil sample, but at the same time it may provide useful 'in situ' test data and has possibilities of developing into a very useful tool for subsurface exploration. — Author's abstract

04219 **Wilson, Stanley D.** Observational data on ground movements related to slope instability: Am. Soc. Civil Engineers Proc., v. 96, paper 7508, Jour. Soil Mechanics and Found. Div., no. SM5, p. 1519-1544, illus., 1970.

Data from field measurements verify the progressive nature of landslides resulting from excavations at the toe of slopes in over-consolidated highly plastic clays and clay-shales, and are in agreement with generally accepted hypotheses concerning the mechanism of such progressive failures. Distribution of such movements changes with time; both total movements and velocities must be reviewed to understand the failure processes. Horizontal movements resulting from construction of embankments on soft clays are shown also to be progressive, and similar to those resulting from cuts in over-consolidated clays. These movements often extend well beyond the toe of the embankment, except when fill is placed on a stiff layer overlying soft materials. Several of the progressive slides were stabilized by corrective treatment. Analysis of field observational data leads to better understanding of failure mechanism and may lead to improved methods of stability analysis. — *from* ASCE abstract

Windisch, C. *See* Ewing, J. 04271

Witherspoon, P. A. *See* Sahores, J. J. 04088

04419 **Witkind, Irving J.** Composite dikes in the Little Belt Mountains, central Montana, *in* Geological Survey research 1970, Chap. C.: U.S. Geol. Survey Prof. Paper 700-C, p. C82-C88, illus., table, 1970.

Three, and possibly four, composite dikes have been recognized in the Little Belt Mountains, central Montana. These dikes, marked by basic margins that contain quartz xenocrysts, and by acidic interiors that contain quartz phenocrysts, imply that two magmas of contrasting composition coexisted and were emplaced almost synchronously. The basic margins consist of kersantite, interpreted as a lighter fraction that formed during the differentiation of an alkalic magma of shonkinitic composition. The acidic interiors consist of quartz porphyries that may stem from acidic magmas which possibly formed by selective fusion of certain metasedimentary rocks of the Belt Supergroup. — Author's abstract

03936 **Witty, J. E.; Arnold, R. W.** Some Folists on Whiteface Mountain, New York: Soil Sci. Soc. America Proc., v. 34, no. 4, p. 653-657, illus., table, 1970.

The morphology, distribution, and classification of some nonsaturated organic soils as they occur on Whiteface Mountain in New York are discussed. These Folists consist of strongly acid O horizons overlying bedrock or fragmental materials. Above 760-m elevation these soils occur as relatively pure units on narrow ridge crests and on steep mountain slopes whereas on less steep slopes they are closely associated with Spodosols. At the subgroup level the soils are classified as Lithic Borofolists and Typic Borofolists. — Soil brief

04147 **Wolfe, L. A.; Zeitlin, H.** An X-ray fluorescence spectroscopic method for the determination of total manganese in rocks and marine sediments [with French and German abs.]: Anal. Chim. Acta, v. 51, no. 3, p. 349-354, illus., tables, 1970.

A method for the determination of manganese by X-ray fluorescence is described. By using scattered X-rays as an internal standard, a linear calibration plot is obtained for standard rocks that agrees with the chemical data. The scattered X-ray method, compared with a widely used net-intensity method, shows improvement in accuracy especially at higher concentrations. — Authors' abstract

04449 **Wolgemuth, K.; Broecker, W. S.** Barium in sea water: Earth and Planetary Sci. Letters, v. 8, no. 5, p. 372-378, illus., tables, 1970.

Vertical profiles of barium content have been determined in the Atlantic and Pacific Oceans by the isotope dilution method. The Atlantic shows a range of from 8 to 14 and the Pacific from 8 to 31 μg/l (surface to deep water, respectively). Although

similar in magnitude to those of previous workers, these results differ significantly in detail. They confirm the hypothesis that barium is incorporated into the remains of organisms in the surface ocean and released to the deep sea as the organic debris sinks toward the bottom. The greater surface to deep concentration increase observed in the Pacific is consistent with that found for other biologically active elements (i.e., Si, C, N, P, . . .). The similarity of Ba and Ra profiles supports the expected chemical coherence between these elements. — Author's abstract

04192 **Wood, Albert E.** The early Oligocene rodent *Ardynomys* (Family Cylindrodontidae) from Mongolia and Montana: Am. Mus. Novitates, no. 2418, 18 p., illus., table, 1970.

All available material of this genus, from the early Oligocene of Mongolia, Montana, and Trans-Pecos Texas, and middle Oligocene of Kazakhstan is reviewed and re-evaluated. There is considerable doubt whether the Montana material, *A. occidentalis*, is correctly referable to *Ardynomys*. Evidence implies that *A. olseni* and *A. occidentalis* are congeneric. There seems to be no reason for considering *A. chihi* as anything but a synonym of *A. olseni*. A redescription of the Asian material is given. For the present, the most conservative taxonomic arrangement is to consider that *Cyclomylus* and *Tsaganomys* are cylindrodonts, derived from *Ardynomys*, and to leave open the possibility of a cylindrodont-bathyergid relationship. — ESL

Wood, Gordon H., Jr. *See* Hosterman, John W. 04248

04039 **Woods, Mary Louise.** Geolibrarianship: Compass, v. 47, no. 3, p. 188-191, 1970.

Geolibrarianship is the most exciting and challenging profession within the geosciences today. The rapidly increasing mountain of literature threatens to bury the scientist. The geolibrarian must cope with this problem as he faces other challenges in his profession. The future is unlimited for the geologist interested in literature — a principal tool of scientific communication. — Author's abstract

Woods, R. D. *See* Richart, F. E. 03799

Wright, F. F. *See* Reimnitz, Erk. 04244

Wright, R. J. *See* Manuel, O. K. 04273

Wright, Thomas L. *See* Jackson, Everett D. 04350

Wu, S. M. *See* DeGeoffroy, J. 03988

Wu, S. M. *See* DeGeoffroy, J. 04282

Wu, S. M. *See* DeGeoffroy, J. 04432

Yang, Suh Y. *See* Selander, Robert K. 03871

04208 **Yeats, Robert S.; McLaughlin, W. A.** Potassium-argon mineral age of an ash bed in the Pico Formation, Ventura basin, Calif., *in* Radiometric dating and paleontologic zonation: Geol. Soc. America Spec. Paper 124, p. 173-206, illus., tables, 1970.

Eight mineral separations from two localities give a mean K-Ar age of about 8.7 m.y. for a volcanic ash layer, 2-10 cm thick, in this Pliocene formation (Wheelerian Microfaunal Stage). Included biotite, sanidine and plagioclase, and microcrystalline aggregates of feldspar all give concordant ages; they show euhedral grain boundaries, and some feldspars have glass rinds. The isotropic matrix, 95 percent glass, seemed unaltered; but discordant glass ages confirm it as useless in radiometric dating. The ash layer is near base of the Santa Barbara Zone, defined by a molluscan assemblage like that now living in Pacific Northwest waters. Temperature shift from a warm-water assemblage in underlying beds to cold-water Santa Barbara fauna had been correlated with onset of Pleistocene glaciation; folding in beds containing cold-water fauna was considered intra-Pleistocene. The new radiometric age suggests Pliocene for both the molluscan temperature shift and the orogeny. — GDC

04189 **Yochelson, Ellis L.** The Early Cambrian fossil *Salterella conulata* Clark in eastern North America: U.S. Geol. Survey Prof. Paper 683-B, p. B1-B10, illus., 1970.

Salterella conulata Clark from the Levis Conglomerate at Levis, Quebec, is redescribed from thin sections of topotype material and from additional specimens. This Early Cambrian form does not show septation and thus is not a cephalopod, contrary to an opinion that has been presented in the literature. The species is widespread in eastern North America. Only two occurrences of the species in place in a stratigraphic sequence can presently be demonstrated, but when local occurrences are more precisely documented, it is likely that this form will have considerable utility for correlation within rocks from the later part of the Lower Cambrian. — Author's abstract

Yoder, H. S., Jr. *See* Huckenholz, H. G. 04287

03946 **Young, Fred D.** Soil grinding mill [with French abs.]: Canadian Geotech. Jour., v. 7, no. 3, p. 339-340, illus., 1970.

A laboratory soil grinding mill, capable of unattended pulverizing and sieving of soils for testing purposes, has been developed by the Materials and Research Branch of the Manitoba Department of Transportation. The cylindrical aluminum mills contain one or more steel rods of suitable weight and diameter, encased in heavy rubber tubing. A screened hatch on each mill allows crushed soils particles to escape when they have reached the required sieve size. The mills, one or a series, are placed so that circular end plates rest comfortably on two rollers, one of which is connected by pulleys to an electric motor. The ground and sieved soil is collected in a pan beneath them. No supervision of the process is required, the grinding is not susceptible to operator variations, and the product is automatically sieved to necessary size. — GDC

Youngberg, C. T. *See* Chichester, F. W. 04278

04081 **Yund, Richard A.; McCallister, Robert H.** Kinetics and mechanisms of exsolution: Chem. Geology, v. 6, no. 1, p. 5-30, illus., 1970.

The three principal exsolution mechanisms are continuous, discontinuous (cellular), and spinodal decomposition. The two former are initiated by a nucleation event, but the latter involves formation of a duplex cell. Growth of this cell may be limited only by boundary diffusion and hence occurs at a faster rate than growth limited by volume diffusion. Alternately, growth may be limited by interface mobility. Spinodal decomposition involves a different type of fluctuation and conditions for it are severely limited by strain energy. Theories of isothermal and continuous cooling transformation kinetics are reviewed and their limitation considered. The influence of impurities, imperfections, degree of supersaturation, and pressure on transformation kinetics is emphasized. Suggestions are made concerning general and specific application of these concepts to exsolution reactions in minerals. — *from* Authors' abstract

04349 **Yund, Richard A.; Hall, Henry T.** Kinetics and mechanism of pyrite exsolution from pyrrhotite: Jour. Petrology, v. 11, no. 2, p. 381-404, illus., tables, 1970.

The exsolution process occurs by a so-called continuous mechanism involving nucleation of pyrite and growth largely by volume diffusion. Rate of nucleation increases with increased supersaturation. Impurities rather than sulfur atoms are rate-determining factors. The presence of as little as 50 ppm of As, Sb, or Bi retards the exsolution rate by several orders of magnitude at 325°C. — MS

Zeitlin, H. *See* Wolfe, L. A. 04147

Zeitlin, Harry. *See* Kim, Young S. 04216

Zeman, Z. P. *See* Thorley, A. 04177

03889 **Zimmerman, Richard A.** Sedimentary features in the Meggen barite-pyrite-sphalerite deposit and a comparison with the Arkansas barite deposits: Neues Jahrb. Mineralogie Abh., v. 113, no. 2, p. 179-214, illus., 1970.

An analysis of the layering features of stratigraphic sections, hand specimens, thin and polished sections of the Meggen Lager and Lenneschiefer (mostly underground mine cross-sections) revealed types of fabrics characteristic of a formation by sedimentary and diagenetic processes. Particular features in the barite include the lenticular form and arrangement of lenses of fine-grained barite. In the pyrite part, the Meggen Lager and Lenneschiefer display geopetal features, rhythmic banding, compaction structures and a succession of layers which would suggest a normal deposition by sedimentation similar to that described in Arkansas by [Zimmermann]. — Author's abstract

04178 **Zimmermann, Joan.** Answering the question when?: Chemistry, v. 43. no. 7, p. 22-27, illus., 1970.

Methods used for dating rocks and minerals, fossil and subfossil remains, and artifacts are summarized in a popular account. Absolute-age methods include: the isotopic methods C-14, K-Ar, Pa-Th, Sr-Rb, Pb-Pb, U-Pb, Th-Pb, etc., and fission-track dating. Relative dating methods include: paleomagnetism (archeomagnetism for baked clay artifacts); fluorine-absorption, uranium-absorption, and nitrogen-loss in bones; thermoluminescence (for baked clay); dendrochronology (tree rings); pollen analysis; varve analysis; obsidian dating (hydration layers in chipped artifacts). — VMJ

Zlony, J. I. *See* Rogers, C. L. 04246

04026 **Zohdy, Adel A. R.** Electrical resistivity sounding with an L-shaped array: U.S. Geol. Survey Bull. 1313-C, p. C1-C20, illus., table, 1970.

The effect of the distant current electrode in an L-shaped bipole-dipole perpendicular array on the value of apparent resistivity is analyzed. Formulas are derived for transforming Schlumberger sounding curves into yL sounding curves and for determining the electrode spacing ratios for which a yL sounding curve does not differ from a Schlumberger curve by more than 2 percent. Mathematical and field procedures are described for transforming yL sounding curves into Schlumberger curves. — AARZ

03797 **Zullo, Victor A.; Hertlein, Leo G.** Catalog of specimens in the type collection of the Department of Geology, California Academy of Sciences — Cephalopoda: California Acad. Sci. Occasional Paper 82, 130 p., 1970.

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